THE

# ELECTRICAL REVIEW.

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## ELECTRICAL REVIEW.

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THE

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## THE STEAM TURBINE IN ELECTRICAL ENGINEERING.

WE have, for several years, insisted on the valuable qualities of the steam turbine as a prime mover for electric generators, and we regard the paper recently read before the Institution of Electrical Engineers as at any rate well timed, coming, as it does, at a moment when the attention of engineers in all parts of the world is concentrated upon this subject. We are especially pleased to note that the original inventor, the Hon. C. A. Parsons, whose claims to that distinction were cordially recognised by various speakers in the discussion, associated with himself in the development of the Parsons turbine, and as joint authors of the paper, his colleagues, Messrs. G. G. Stoney and C. P. Martin, who, he said, had worked with him from the commencement. The tribute paid to Mr. Parsons by Mr. G. Insull, the well-known head of the Chicago electricity supply undertaking, must have been especially gratifying to him.

The paper consists mainly of an historical outline of the development of the Parsons turbine from 1884 to date, with a summary of the principal results obtainable from turbines of various outputs at the present day, there being little of novel character in it beyond the description of the "vacuum augmentor," and nothing at all about other types of steam turbine. In fact, the paper ought rather to have been called "The Parsons Steam Turbine," on this account, and it is to be regretted that the authors refrained from any expression of opinion as to the merits of the rival types.

Engineers are awaiting with keen interest the authoritative announcement of the results obtained with the large Curtis turbines now running in America, and of the 10,000-H.P. Parsons turbine in course of construction on the Continent. Fortunately Mr. Insull was able to give some interesting particulars relating to the 6,000-KW. Curtis turbines in one of his Chicago power stations, which, he said, gave results 30 per cent. better than the plant in a reciprocating engine station of 17,000 KW. Mr. Merz also contributed the first independent statement of an efficiency test of a Curtis turbine — namely, a 500-KW. set which he has installed at Cork. This set consumed 20·5 lb. of steam per KW.-hour, with a vacuum of 27 in., and steam at 150 lb. pressure, superheated 100° F. Mr. Merz stated that with a vacuum of 28½ in. and 150° superheat, the steam consumption would have been reduced to less than 19 lbs. These results, while they do not excel those obtained with the Parsons turbine under similar conditions, show that there is not much to choose between the two types so far as steam consumption is concerned, and according to Mr. Stoney, the floor space occupied, as well as the capital cost, is about the same in each case. Doubtless, a quantity of valuable information as to the performance of the various types of turbine will be forthcoming next week at the joint meeting of

Mechanical Engineers in Chicago, where no fewer than four papers on turbines are announced to be read; this fact alone would suffice to indicate the extraordinary manner in which during the last few years the turbine has aroused the interest of the engineering world.

But how goes it with the gas engine? The contest seems to be one between low fuel costs and low capital charges, in which the latter scores an easy victory—at present. But it must not be supposed that the gas engine will always be more costly than the steam turbine. The course of evolution of the gas engine somewhat resembles that of the turbine, which was almost ignored whilst it was built only in small sizes, but sprang into the front rank directly the large turbine became a reality. Although under present conditions fuel costs are undoubtedly of less importance than capital charges, great changes may take place, and load factors may improve to such an extent as to completely reverse the situation. Further, the cost of gas engines and producers, which must be taken together, may quite possibly be brought below that of turbines together with boilers and auxiliaries; and in the south, where coal is costly, the fuel consideration becomes more weighty. The possibility of producing a satisfactory gas turbine is always present, and if it were realised would settle the matter at once; but there is no immediate prospect of this being done, and there are enormous difficulties to be overcome before success can be attained.

There is, however, an important question which has been almost passed over in the recent discussions—namely, if we grant that the steam turbine is at present master of the field in large power stations, to what extent is this true of the smaller installations? In moderate sizes—below, say, 500 KW.—the gas engine has only to compete with the reciprocating steam engine, and we believe that under these conditions the gas-driven station, properly designed and operated, is already able to show results at least as good as, and probably better than, any steam-driven plant of equal size in total costs per unit.

---

The Price and Quality of Rubber.

It has been said that general ignorance obtains on the important subject of rubber in its relation to the electrical industry. The probability is that the comment is scarcely unwarranted. Recollections of recent law cases bring back the memory of how expert witness after expert witness hurriedly disclaimed any desire to pose as the possessor of a knowledge of rubber. In one case especially, where the whole point at issue lay in the quality of the rubber used in the insulation, every other point was argued but the main one, bringing about a somewhat ludicrous state of affairs. If this lack of knowledge obtains in this branch of the industry, how much greater must it be in the others. It would be amusing were it not so serious, to hear the frequent stipulations as regards the use of the best Para in insulation, when the price quoted must necessarily forbid its use entirely, or only in a very attenuated form. The price of Para rubber has for some time been well over 4s. 9d. per lb. in its crude state, and on an average 15 per cent. of the crude rubber is lost before it finishes its course through the washing and drying processes. It may be taken, therefore, that the material ready for manufacture costs at least 5s. 6d. per lb. It is fairly easy for any reader to calculate the weight of the insulation, and the price he paid for the rubber in it, apart from anything else. On the basis of the prices which too generally obtain nowadays, the investigator will be forced to the conclusion either that the manufacturer is a philanthropist, or that the insulation is "very much mixed" rubber.

Dismissing the first hypothesis (with regret), the investigator is now face to face with the position into which his, and others', keenness in buying has forced the manufacturer. Let us make our views quite clear. There is as good insulated wire manufactured now as ever there was, but, unfortunately, much of the stuff bought nowadays does not merit this description. The manufacturer has been forced by his customers into making an insulation which would have been scorned years ago. It is true his more perfect knowledge has enabled him to use his materials to better advantage, but the process of cheapening must have an end somewhere and at some time, and it is time everyone in the electrical industry realised it; manufacturers are only to be blamed in so far that they have given way to a demand for an article at a certain price. The demand has been made by those who should be in a position to know the circumstances of the case, and to judge of what is necessary. We incline to the opinion that a more adequate knowledge of rubber and the price of it would, in a large measure, bring about a better state of affairs. It is for the credit of the industry that the work it does should at all times be work well done. How is it possible to accomplish this, when the very material that is relied upon for protection is attenuated to such an extreme degree as to scarcely hold together, far less give protection?

This may appear an exaggerated view, yet it is apparent at times at the present moment, and is the inevitable goal to which we are speeding. Rubber insulation is, and always should be, a non-conductor of electricity, able to withstand the ravages of time, and the more or less accidental attacks of the elements. Good rubber insulation can do all these things better than any other practical material. Inferior rubber insulation can only do these things in the ratio of its inferiority. However skilfully chosen and skilfully prepared are the other ingredients of a rubber-cum-something-else insulation, it must always be remembered that none of these can supplant rubber in its properties, and most of them tend to its earlier disintegration and the consequent loss of its properties. It lies with the electrical industry to say how much further the cheapening process on certain classes of work is to be carried. It is its credit, and its credit alone, that is imperilled. It is nothing to the public that the contractor may have had the fixing of the price. The makers had the expert knowledge, and with them rested (in the opinion of the public) the right to say what quality of material should be used.

We know, of course, that so long as any man has the power (no matter whether he be the most ignorant on earth) to use the title of electrician, so long will there be those to whom the credit of the industry is as nothing. No appeals would touch such a man, except an appeal to his pocket. It is to the more responsible members of the industry that we put the question, whether it is not time to cry a halt to this process of dangerous cheapening?

---

State Purchase of Australian Cables.

In the Australian Federal Parliament a few weeks ago Senator Keating asked the Vice-President of the Executive Council, upon notice—

**Will the Government, if it has no objection, cause to be placed upon the table of the Senate copies of all documents relative to its negotiations with the Eastern Extension Telegraph Co. in connection with the purchase of the Tasmanian Cable, including any opinion or opinions that may have been taken as to whether the cost of such a purchase would be new or transferred expenditure?**

**Senator Playford in reply said: It is not considered to be desirable to make the documents in connection with this matter public.**

The above is an extract from the official report of the recent debates of the Federal Parliament.

For some time back rumours of such negotiations have appeared in the London Press, but the figures quoted as the amount demanded by the Eastern Extension Co. have been so absurd as to discredit even the truth of any such negotiation. The first of these two cables was laid in 1869—35 years ago—the second was laid 19 years ago; they are both about 180 miles long, and in view of the fact that liberal subsidies have been paid for them by the Tasmanian Government, and remembering at the same time that the late Sir John Pender, an acknowledged authority on these subjects, dealt with the embryo Pacific cable on a basis of a 14 years' life, when opposing the Pacific cable project in the columns of the *Times* some years ago in discussion with Sir Charles Tupper; we cannot surely be far wrong in suggesting that as a token of contrition and reparation, the Eastern Extension Co. should present these cables, for what they are worth, to the Commonwealth, a graceful act which would cost them nothing.

## INDUCTION COIL DESIGN.

By MORTIMER A. CODD.

(*Concluded from page* 854.)

In the cylindrical winding the ebonite tube can be done away with entirely, thus bringing the first turns of secondary much nearer the core, so that the inner end can be earthed.

Let *a*, *b*, *c*, *d*, *e*, fig. 3, represent the insulation between the layers of secondary. As these layers are not more than $\frac{1}{32}$ in. thick, it is quite an easy matter to insulate the

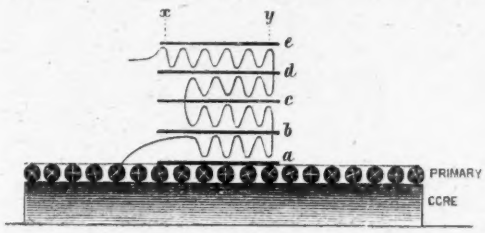



Fig. 3.

layers from each other, but suppose that the last layer, *d*, *e*, is less than the maximum sparking distance from *a*, *b*, a spark will naturally jump between the last layer and earth.

For instance, suppose the number of layers *a*, *b*, *c*, &c., to be 32, and the height from *a* to *e* 1 in., then each layer must only be made sufficiently long from *x* to *y* to give a spark of not more than $\frac{1}{32}$.

It is seen, then, that at present sparks of only moderate length can be produced by this method; but by using two cylinder sections on the same core, with their inner ends earthed and an ebonite disc between, much larger sparks may be obtained, though this has the disadvantage of leaving the best magnetic part of the core (the middle) unused.

An iron core having a length 12 times its own diameter was wound with a primary, and over this were slipped test coils of different diameters, but having a fixed number of turns and connected to a hot-wire voltmeter. The test coils were from $1\frac{1}{2}$ in. to $7\frac{1}{2}$ in. in diameter respectively. The primary was connected to the mains through an electrolytic interrupter and the current was kept constant.

From the curves, fig. 4, it will be seen that the induced E.M.F. falls off rapidly from about the middle third of the core, though less rapidly proportionally with the turns that are furthest from the core.

Curve 5 shows that the effect produced in the secondary diminishes almost proportionally with the distance from the core, so that every care should be taken to bring the outermost turns as near the core as possible.

There is probably little difference in the values of the capacity effect of the secondary in section and cylinder-wound coils. In the former the capacity must necessarily be the sum of the capacities of each section separately, and in the latter the sum of the capacities of each layer separately, and as, with ordinary frequencies, it does not seem to play a preponderating part, it appears unnecessary to make provision for a greater current by enlarging the secondary wire.

As the P.D. at the secondary terminals is so great, and the current required is small, the resistance of the secondary may be made high, and for most purposes No. 36 wire is ample. In fact, for the satisfactory production of X-rays, which seem to depend less on the energy transmitted than on the pressure used, much finer wires might with advantage be employed, were they commercially practicable.

From the foregoing remarks we may draw the following conclusions, though, in many places, theories seem antagonistic, and admit the factor of personal judgement:—

1. The core should be in length about 12 times its greatest diameter.

2. The primary should wholly overwind the core, the number of layers being kept small, preferably to a single layer.

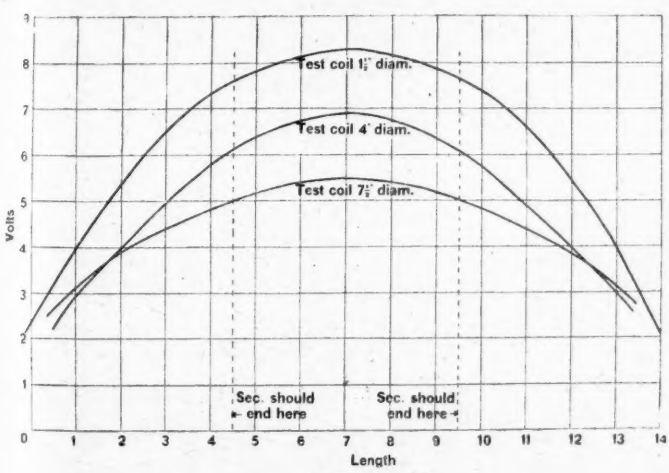



Fig. 4.

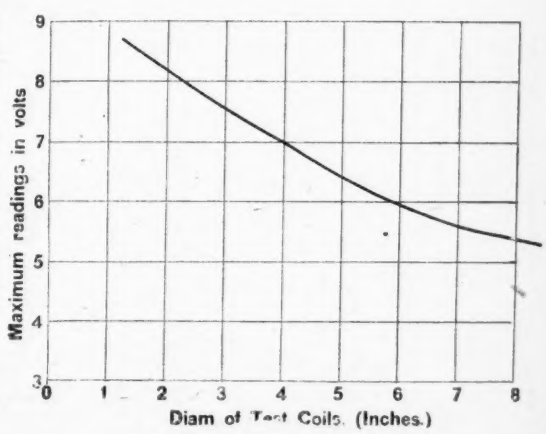



Fig. 5.

If more than two cylinder sections be used it is necessary to revert to the ebonite tube, thus losing one of the advantages of cylinder windings, while if a great number of sections be used, and the insulation between layers be omitted, one has then but the usual multi-sectional coil.

The making of secondaries having a large external diameter is to be deprecated, because for every turn on the outside layer three or four times as much wire is used as on the inside turns, with a corresponding increase in resistance and expense.

The opposite extreme, however, of making the coil long and thin, should not be adopted, as the induction at the ends of the core is low.

Two such secondaries, one long and thin, the other short and dumpy, were constructed, but the difference in the results was not very marked, being, if anything, in favour of the short secondary. With a view to finding the best position for the secondary, the following experiments were carried out:—

3. The secondary should not be made much more than one-third the total length of the core, nor its greatest diameter much more than three times the diameter of the core.

4. The length of the secondary wire should be as short as possible, and the size of the secondary as small as is compatible with good insulation.

5. The condenser should be balanced with the self-induction of the primary and adjustable for varying currents and self-induction.

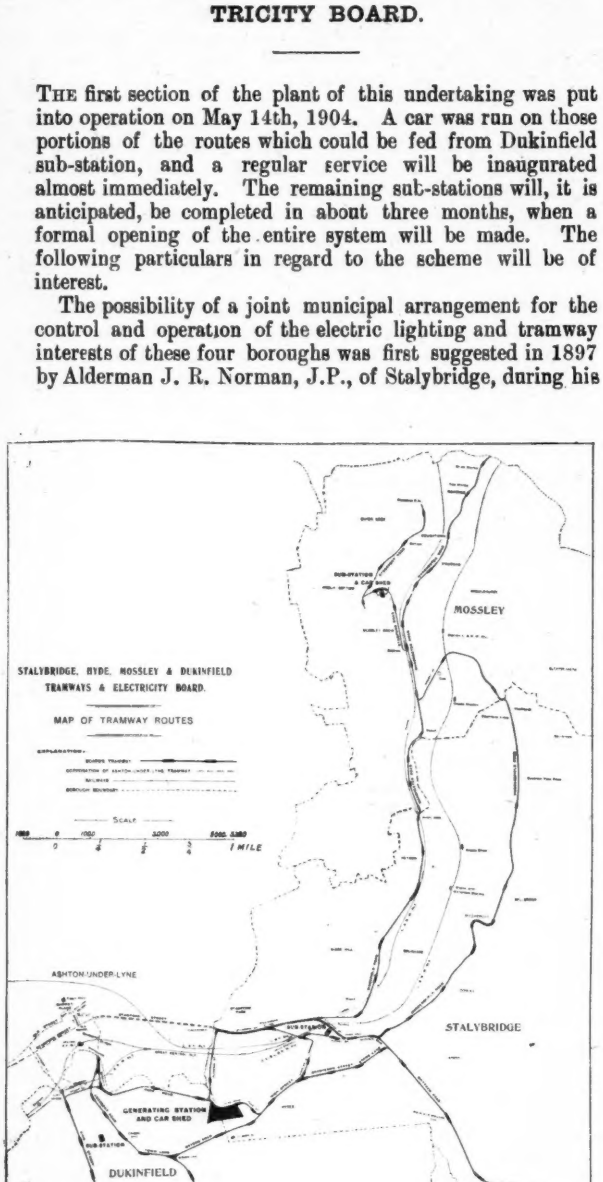
6. Nearly closed magnetic circuits are not (except for special purposes) at present practicable, but partly-closed circuits (*e.g.*, hedgehogged ends) are advantageous.

**King's College Annual Dinner.**—The forty-fourth annual dinner of this college is to be held at the Hotel Cecil, on Monday, June 20th, with the Marquess of Salisbury in the chair.

## THE STALYBRIDGE, HYDE, MOSSLEY AND DUKINFIELD TRAMWAYS AND ELECTRICITY BOARD.

THE first section of the plant of this undertaking was put into operation on May 14th, 1904. A car was run on those portions of the routes which could be fed from Dukinfield sub-station, and a regular service will be inaugurated almost immediately. The remaining sub-stations will, it is anticipated, be completed in about three months, when a formal opening of the entire system will be made. The following particulars in regard to the scheme will be of interest.

The possibility of a joint municipal arrangement for the control and operation of the electric lighting and tramway interests of these four boroughs was first suggested in 1897 by Alderman J. R. Norman, J.P., of Stalybridge, during his




mayoralty. A joint Committee was afterwards formed, and an inspection made of various electric lighting and tramway systems in the country, among the places being Bradford, where the first joint municipal electric lighting and tramway station, designed and managed by Mr. A. H. Gibbings, was in operation.

Mr. Gibbings had just commenced a consulting practice, and was selected by the joint Committee to make a full and detailed report on the proposed scheme. The report was submitted on April 11th, 1900, and supplemented on June 8th, 1900, when it was unanimously adopted, the joint Committee deciding to go forward for a special Act. Mr. Gibbings was retained as consulting engineer, and the four borough surveyors prepared the Parliamentary plans in their respective districts.

The Act, known as the Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board Act, 1901, was duly obtained in August, 1901, constituting a Board of six representatives from the Councils of each of the boroughs, or 24 members in all, and on January 1st, 1902, Mr. Gibbings commenced to design the scheme.

A reference to the accompanying plan of the area will show that the boundaries of the several boroughs are contiguous the one to the other for a considerable length. The total area contains 11,399 acres, and a population of about 100,000 inhabitants. It is situated east of Manchester, and is bounded by the following towns and urban districts, viz., Ashton-under-Lyne, Guide Bridge, Audenshaw, Denton, Stockport, Woodley, Mottram, Hollingworth, Greenfield, Saddleworth, Lees, and Hurst, having a population over 180,000. Stalybridge is distant from Manchester about seven miles, and the tramway will be in direct communication with the Manchester Corporation tramways, through Ashton-under-Lyne, to which town the Manchester trams now run.

The Board's system is also in immediate touch, though no physical connection is made, with the Oldham, Ashton, and Hyde tramways, the Ashton-under-Lyne Corporation tramways, the Stockport Corporation tramways, and the Glossop tramways.

The area, in fact, is an important one, including one of the principal districts of the cotton trade.

The system of generation comprises a main generating station, and four sub-stations. Electricity is generated at 6,000 volts three-phase alternating current at 40 periods, and transmitted to the sub-stations where it is transformed and distributed as direct-current to lighting and tramway feeders. Each of the four towns has a complete network of lighting mains.

The tramway track consists almost entirely of single line with turnouts, the exception being ¾ mile of double track in Stalybridge. The route length of track is 21 miles 390 yards, of which 6 miles 667 yards is double line. The gauge is the standard 4 ft. 8½ in., uniform with the gauge of the adjoining tramway systems.

The various contractors for the work are as follows :—

| | |
|---|---|
| Foundations of generating station | Wellerman Bros. & Co., Hyde. |
| Superstructure " " | W. Storrs, Sons & Co., Ltd., Stalybridge. |
| Ironwork " " | E. F. Blakeley & Co., Liverpool. |
| Main car-shed at " " | Saxon Bros. & Co., Stalybridge. |
| Ironwork shed " " | E. F. Blakeley & Co., Liverpool. |
| Stalybridge sub-station ... ... | J. Ridyard, Ashton-under-Lyne. |
| Dukinfield " ... ... | Saxon Bros. & Co., Stalybridge. |
| Mossley " ... ... | S. & J. Smethurst, Oldham. |
| Hyde " ... ... | Saxon Bros. & Co., Stalybridge. |
| Ironwork for four sub-stations and Hyde and Mossley car-sheds | Ed. Wood & Co., Ltd, Manchester. |
| Rails, anchorplates and fishplates | Bolckow, Vaughan & Co., Ltd., Middlesbrough. |
| Points and crossings ... ... | Hadfield's Steel Foundry Co., Ltd., Sheffield. |
| Tiebars, rivets and bolts ... ... | Bayliss, Jones & Bayliss, Wolverhampton. |
| Trolley wire ... ... ... | British Insulated and Helsby Cables Co., Ltd., Prescot. |
| Three 500-KW. steam alternators | Dick, Kerr & Co., Ltd., Preston. |
| Three 50-KW. steam exciters ... | J. P. Hall & Co., Ltd., Oldham. |
| Three 750-H.P. triple-expansion engines (sub-contract) | Yates & Thom, Blackburn. |
| Three 75-H.P. high-speed engines (sub-contract). | Belliss & Morcom, Birmingham. |
| Permanent-way and conduits (Stalybridge and Mossley). | Wm. Underwood & Bros., Dukinfield. |
| Permanent-way and conduits (Hyde and Dukinfield) | Dick, Kerr & Co., Ltd., London. |
| Six Lancashire boilers ... ... | Tinker, Shenton & Co., Ltd., Hyde. |
| Economisers ... ... ... | Goodbrand & Co., Stalybridge. |
| Condenser, pumps, pipes and ironwork, &c. | Sir Hiram Maxim Electrical and Engineering Co., Ltd., London. |
| Travelling crane ... ... ... | Higginbottom & Mannock, West Gorton. |
| Motor-generators, &c. ... ... | Witting, Eborall & Co., Ltd., London. |
| Four batteries of accumulators ... | Tudor Accumulator Co., Ltd., Dukinfield. |
| Four hand cranes for sub-stations | Herbert Morris & Bastert, Ltd., Loughborough. |
| Extra H.T. cables ... ... ... | British Insulated and Helsby Cables, Ltd., Prescot. |

| | |
|---|---|
| Low-tension cables ... ... | W. T. Glover & Co., Ltd., Manchester. |
| High and low-tension switch-boards | Witting, Eborall & Co., Ltd., London. |
| Tramcars ... ... ... ... | British Westinghouse Elec. and Mfg. Co., Ltd., Manchester. |
| Overhead equipment ... ... | Dick, Kerr & Co., Ltd., London. |

We are glad to see that the Board has adopted a reasonable scale of charges, and offered other inducements to the public in the initial stage of the undertaking. The charge per unit for lighting purposes will be 4d.; the charge for motive power purposes and electric heating, &c., will be at the maximum rate of 2d. per unit, with a sliding scale of rebates down to 1d. per unit. No doubt these prices will be further reduced as soon as a demand has arisen. The Tramways Department will be charged 1½d. per unit for all electric energy supplied for that purpose.

As a further encouragement, it has been decided not to make any charge, either as a rental or otherwise, for meters, cut-outs, and switches on service connections. No charge for service cables will be made up to a distance of 60 ft. from the nearest main, whether a part of such service cables are on private property or not. Thus the consumer will find his liability defined and limited by the charge per unit.

The Board has also adopted a scheme for hiring out motors, on similar lines to that which was so successfully inaugurated by Mr. Gibbings at Bradford in 1897. The sizes to be obtained will range from ½ H.P. to 20 H.P., and a large demand is anticipated. Here, again, the charges usually made for fixing and periodical inspection are merged in the rental.

The adoption of a bold policy, such as is outlined above, in the commercial department of the undertaking at this early stage, reflects great credit on the Board and its adviser. Enterprise of this order is not particularly common in new concerns, but, in the few instances where it has been present, the undertakings have rapidly developed into successful enterprises, and amply justified the far-sighted policy adopted.

## LEGAL.

### Llanelly Tramways Co., Ltd., v. The Llanelly and District Electric Lighting, &c., Co., Ltd., and Others.

In the Chancery Division of the High Court of Justice on Wednesday, May 18th, Mr. Justice Joyce delivered his reserved judgement in the action brought by the Llanelly Tramways Co., Ltd., against the Llanelly and District Electric Lighting, &c., Co., Ltd., and the British Insulated and Helsby Cables, Ltd. (formerly the British Insulated Wire Co., Ltd.). The plaintiffs claimed specific performance of an agreement dated October 22nd, 1900, for the sale by the plaintiffs to the defendants of a piece of ground in the Parish of Llanelly, together with certain buildings erected thereon, the tramway undertaking and certain tramcars.

His Lordship, in giving judgement, said, in 1900, the Wire Company, for very good reasons, was desirous of acquiring the plaintiff tramway undertaking. By an agreement of December 4th, 1899, between the local authority and the Wire Company, the latter agreed to apply for an order under the Light Railway Act of 1896, to carry out a scheme of electric tramways in Llanelly, and to acquire the plaintiffs' existing tramways. It was further agreed that the Wire Company should find all such capital as should be required for carrying out the objects, and the local authority, subject to the approval of the Board of Trade, were to give their consent to a subsidiary company to be formed which should acquire the plaintiff company's undertaking, provided the Wire Company guaranteed the capital of the subsidiary company to the satisfaction of the local authority. A clear and definite bargain was concluded between the tramway company and the Wire Company for the sale by the former, and the purchase by the latter of the tramway undertaking and assets for £5,000. It was suggested by the Wire Company that the letters and telegrams did not constitute a valid document, but he was not aware of the existence of any ground for that contention. It was true that in one of the letters confirming the offer to purchase the solicitors said the offer was subject to the grant of the light railway order. If, in truth, that was ever a condition, it had been fulfilled, inasmuch as the application for such order had been granted long before the commencement of the action. The letter concluding the agreement for sale was dated August 19th, 1900, the Wire Company agreeing to purchase the property free of all liabilities. The solicitors of the Wire Company on August 17th applied for a draft agreement, together with abstract of title, and said that the Wire Company wished them to carry the matter through. The tramway company replied that no formal contract was necessary, but an abstract of title was forwarded shortly afterwards. On October 6th the tramway company submitted a draft of a formal agreement between themselves and the Wire Company, but the latter returned it with a letter stating that the purchasing company in whose name the light railway application was to be made was the Llanelly and District Electric Lighting and Traction Co. That was the first reference to the traction company. The traction company had been formed by the Wire Company at a date prior to the agreement between the Wire Company and the local authority. In their answers to interrogations, the officers of the Wire Company stated that the Wire Company gave instructions for and paid the costs of the preparation of the memorandum and articles of association of the traction company, and procured seven persons to subscribe for the seven shares. No other shares had been issued, and the seven shares were the property of the Wire Company. For all practical purposes this was nothing more than a name; in a commercial sense it had never had any real existence. The value of its assets was less than it was, and the company was the mere nominee or creature of the Wire Company. The Wire Company had long been established, and had a large capital and abundant resources. On October 17th the Wire Company's solicitors inserted the name of the traction company in the draft agreement, and proposed that the agreement should be conditional on obtaining the light railway order. No objection was raised by the tramways company, and on October 22nd a new agreement was sealed between the tramway company and the traction company, such agreement being expressed to be subject to the approval of the Board of Trade. There had never been any express agreement for the release or discharge of the Wire Company from its obligations under the agreement made in August, 1900, nor was there any agreement by the tramways company to accept the worthless responsibilities of the traction company instead of the liability of the Wire Company with its large capital and resources. He held, as a matter of fact, that the tramway company and its advisers never agreed or intended to release the Wire Company, and that if they had in point of law done so by entering into the agreement with the tramway company, they did so unintentionally and by inadvertance. The plaintiffs had always looked to the Wire Company to find the money and complete the purchase, either in the name of the traction company or otherwise. The Wire Company and its advisers only recently entertained this view of their legal position. Did they intend by the agreement of October 22nd to obtain a discharge from their previously existing liability, and was the agreement procured in the name of the traction company, and were the letters written by the solicitors of the Wire Company in pursuance of a covert design to effect a discharge? The solicitors had not appeared in the witness box, and it would not be right for him to attribute to them any such dealings as he had referred to. The consent of the Board of Trade had not, and could not, be obtained from the Board of Trade unless the company had sufficient means to carry out the undertaking. In other words, the agreement with the traction company had not been enforceable by either party. In December, 1900, the tramway company began to press the solicitors for the Wire Company for a draft conveyance. The Wire Company put forth various pretexts, but at no time was it suggested that they were not liable. The inquiries of the Board of Trade showed that the Wire Company intended to perform the obligations nominally undertaken by the traction company. It had been stated that the tramway company had been called upon by the local authority to repair the roadway, and generally had been harassed by that authority. They had been obviously placed in a most inconvenient position by the delay, and had shown great forebearance. The solicitors for the Wire Company wrote on August 16th, but nothing was done, and at length the patience of the tramway company was exhausted, and the action was commenced at the end of December, 1902. The Wire Company now said that the original contract with the tramway company was superseded by the subsequent agreement of October 22nd, 1900, which was entered into at their request with their nominee and creature, and that the Wire Company had been released from all antecedent responsibility. It was not the fact that there was a release of the Wire Company from its obligations, and, in his Lordship's opinion, it was an afterthought which had not occurred to the advisers of the Wire Company until after the commencement of the action. There must be judgement for the plaintiffs, declaring that the Wire Company had not been discharged or released from its liability under its agreement of August, 1900, and he granted a decree of specific performance of the agreement, an inquiry as to the damages, and the Wire Company must pay the costs. This was not a case in which he would let the Wire Company off one penny of the costs, as he thought honesty required that they should perform the contract.

### Macartney, McElroy & Co., v. Brighton Corporation.

In the King's Bench Division of the High Court of Justice on Friday, May 20th, Mr. Justice Grantham gave his reserved judgement on that portion of the above case which related to work done under Section B, of the contract for work in connection with the laying of the first line of electric tramways in Brighton. The work comprised the wood paving of the roadways. The plaintiffs claimed £16,000, and the jury at the trial of the action awarded them £1,400. The Corporation contended that the price of 12s. 7d. per yard included the cost of excavating, &c., as well as the cost of paving, whereas the plaintiffs said that the price was for wood paving only, and after the trial his Lordship considered this matter with regard to the terms of the contract and tenders.

Mr. Justice Grantham said that the case was one of considerable importance, not only because of the amount involved, but from the matters in dispute and the position of the parties to the litigation. Although the defendants had paid to the plaintiffs £9,000, or more, on account of the work done, they now said that the amount was paid by their engineer under a mistake, and they had deducted that

amount from other sums which they were liable to pay the plaintiffs, so that at the present time they claimed the right to take advantage of the work done without paying for it. If the claim had been made by an individual it would have been a dishonest claim, and it could not have succeeded, but the defendants contended that, being a Corporation, they could and must succeed on the technicalities of the law. The defendants wanted to lay tramways, and they thought it would be a good plan, while the roads were being broken up, to lay down wood paving at the sides of the tramways. Unfortunately the engineers prepared the specification to cover the two classes of work, but they prepared two distinct tenders for the contractors to sign, and the tenders were drafted in an entirely different manner. In his judgement the specification indicated that the wood paving was to include the cost of excavating, &c., but the language of the form of tender seemed equally clearly to leave out that preliminary work, and only to include the cost of the wood paving and the laying of it, while the language of the bill of quantities and schedule of prices, would indicate that the plaintiffs were to be paid for that work and material, according to the prices entered by the plaintiffs in the schedule of prices, when the amount of excavation and quantity of cement used had been ascertained. Carefully reading the specifications, bill of quantities, and forms of tender, the plaintiffs tendered for each class of work according to the forms sent them, and they tendered for each class of work on two different principles. Though ultimately the amounts of the two tenders were added together, the defendants were not in his judgement entitled to deprive the plaintiffs of their money by saying that it was a lump sum contract, and could not be divided. With the exception of one contractor, the plaintiffs' tender for the tramways was a good, fair average one; but for the wood paving their tender was about £12,000 below any others, and Mr. May, the Corporation's resident engineer and surveyor, at once saw what had happened, and sent for the plaintiffs, and suggested they had made a mistake or misunderstood the meaning of the tender, but the plaintiffs said their reading was correct, and they did not think any explanation could be added. The plaintiffs said that Mr. May agreed with their construction, but Mr. May put a different construction on what was said; his evidence, however, had been most unsatisfactory—whether from defective memory or not, he could not say. Almost the only reliable piece of evidence casting doubt on the plaintiffs' contention that Mr. May and the defendants accepted their reading of the tender, was the letter of Mr. May to the Works Committee of January 11th, 1901, and that showed apparently, that at that time Mr. May thought they were going to cheat the plaintiffs out of this £12,000 or £14,000. At that time he admitted that he knew that the plaintiffs had not tendered for the extra £12,000 of work, and yet he was scheming how to divide the money the Corporation would gain. He endeavoured to hide the truth by the suggestion of the one lump sum contract. Mr. Boxall, K.C., one of the learned counsel for the Corporation, during the progress of the case, stated that he was instructed to say, that if the Corporation were wrong in their reading of the construction of the contract, they would not rely on the certificate of their surveyor excluding the plaintiffs from being paid for the work done, and for which the surveyor had refused to certify. It was a very honourable proposal, but had not the verdict of the jury shown them they were wrong? In his judgement the documents were inconsistent. The tender "B" was inconsistent with the specification, but the jury had distinctly found that both parties to the contract had intended to mean a certain thing. The defendants said that did not signify, because they were a Corporation, and unless their contract was under seal they could not be made to pay for work done. But in this case there was a seal and a stamp attached to the contract. If, therefore, when, in an ordinary contract, there had been a mutual mistake in drawing it up, it could be rectified in a Court of Law, should it not be rectified in the case where the contract was right in form, and only wanted altering or rectifying in the language used, merely because it was under seal? He must hold that the contract must be rectified by adding the words, that the plaintiffs would make the excavations, &c., for the foundation for the wood paving, according to the schedule of prices attached to the specification. The verdict and judgement would, therefore, be for the plaintiffs.

Mr. Cautley, M.P., for the plaintiffs, asked for a declaration that the plaintiffs were entitled to the £14,000.

His Lordship agreed that they should have judgement for this amount, subject to it being rectified. Perhaps it would be better to say that he agreed with the finding of the jury for an amount to be ascertained on the basis of the jury's finding. The plaintiffs were also entitled to costs.

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Newcastle-on-Tyne Electric Supply Co. *v.* Ferguson.

At the Newcastle-on-Tyne County Court on the 20th inst., before Judge Greenwell, plaintiffs brought an action against John Ferguson, contractor, of that city, for £44 5s. 7d. as damages for wrongfully disturbing and damaging an electric cable. The cable in question is laid under the public footpath in Pilgrim Street, and it was stated in the particulars of claim that the cable was disconnected by the defendant on December 10th, 1902, and on February 18th, 1903. For these disconnections £1 5s. and £2 7s. were claimed, while £40 13s. 7d. was claimed for laying a new length of cable under the roadway in substitution for that which had been disturbed and damaged.

Mr. Meynell, who appeared for the plaintiffs, said when there was a disconnection of the cable there was a danger of the whole district being plunged into darkness, and if it occurred in the daytime there would be a stoppage of the supply of power to works.

Mr. Dixon, for the defendant, said it was not disputed that Mr. Ferguson's men did the excavations which caused the damage. The material point at issue was as to the exact spot where the cables were laid.

Mr. Meynell said the question was whether they were laid with the consent of the Corporation under the section of the order. The suggestion that the cable was laid nearer to the building than it ought to have been would not hold, as there was no provision as to the distance.

Mr. Dixon, for the defence, pointed out that whereas the plans passed by the Corporation showed that at no place was the cable nearer than 4 ft. 6 in. from the face of the building, the cable was actually in many cases laid within 9 in. His submission was that at the place of the accident the cable was not laid down in accordance with the plans, and that, had it been laid down in accordance with the plans, it would not have been affected by the works of the defendants, because these works would not have extended more than 2 ft. 6 in. from the face of the building.

His Honour found for plaintiffs, and said there was no ground either in law or common sense for the defence set up.

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## PARLIAMENTARY.

Middlesbrough, Stockton-on-Tees and Thornaby Tramways.

For several days a Select Committee of the House of Commons, under the chairmanship of Mr. H. Hobhouse, considered the Bill of the Imperial Tramway Co., to empower the company to construct about six miles of electric tramways in the Boroughs of Middlesbrough, Ormsby, Southbank and Thornaby.

Mr. Balfour Browne, in opening the case, said the Imperial Tramways Co. took over the existing tramways in Middlesbrough in 1879, and it was now proposed to extend the system. The opposition came mainly from the owners of toll bars along the road. The promoters proposed to take an easement over the road where there were three tolls, and compensate the owners, but in the fixing of the price the promoters asked that the arbitrators should take into account the benefit which the toll owners would receive from the tramways. They claimed that although they must pay for running through the toll gates, yet by partly maintaining the roads and in helping to develop the estates, they were benefiting the owners, which ought to be set off against the payment for the easements. In other words, they asked that the principle of betterment should be recognised.

Evidence was given by Mr. J. Clifton Robinson, the engineer to the scheme, who described what lands were proposed to be taken.

The Committee found the preamble of the Bill proved, but struck out that portion of the clause dealing with the question of betterment. With regard to the toll-gates, they passed the clause in the following form:—

> The existing toll-gates on the roads, or portions thereof, along which it is proposed to construct tramways Nos. 1 and 2, shall at all reasonable times be open for the passage of tramcars belonging to the company free of any toll, charge or payment, either in respect of such tramcars or the passengers or other persons therein, and the company may temporarily remove any of the said toll-gates which it may be necessary to remove for the purpose of carrying out any of the works authorised by the Act . . . . providing that the company shall pay such owners in consideration of the rights conferred . . . such sums as may be agreed upon, or failing agreement shall be determined by arbitration.

Further clauses were adjusted on Wednesday (May 18th).

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## CORRESPONDENCE.

*Letters received after first post on Wednesday morning cannot appear until the following week.*

### Disputed Results from a Refuse Destructor.

[Immediately on receipt of Mr. Birkett's letter, published in our issue of 13th inst., we asked Messrs. Meldrum Bros. whether they could supply us with any particulars relating to the Burnley plant. Unfortunately, owing to a postal mishap, we did not receive their reply until too late for inclusion in our last issue.—Eds. E.R.]

We duly received your favour of the 16th inst., and, having perused the paragraph referred to by your correspondent, we are not a little astonished at the tone of Mr. Birkett's letter. He seems to insinuate that the information was supplied by us; but you are doubtless aware that the whole of the information was supplied by the official of the Corporation responsible for the carrying out of the work, viz., the Health Superintendent. If anyone is inclined to doubt the accuracy of his statements, it would be well for him to communicate with either the Burgh Surveyor or the Chairman of the Electricity Committee, either of whom would, we doubt not, confirm practically the whole of the statements contained in the paragraph.

We detect one or two slight inaccuracies in the paragraph, viz., where it is stated that "as much as 15,000 lbs. of steam has been delivered in one hour to the electricity works." This should have read, we think, "As much as 15,000 lbs. of steam has been produced from the one Lancashire boiler in an hour, this boiler being 30 ft. × 8 ft., and fired by unscreened refuse alone." Of course from this 15,000 lbs. has to be deducted that used by the blowers, which would amount to at most 2,000 lbs., probably not exceeding 1,500 lbs., leaving 13,000 lbs. to be passed on to the electrical department.

That the Committees concerned are fully satisfied with the steam-producing capacity of the much-maligned destructor, must be evident to the unbiassed mind, as they have now placed a further order for an exact duplicate of the plant already erected, and are most anxious that we should get it to work at the earliest possible date.

We are collecting additional data showing the actual results at Burnley week by week since the plant started, so as to verify or otherwise the statements so mercilessly run down by the electrical engineer, and we leave the public to draw its own inferences as to whose word is most to be relied on — that of the person who from the beginning was opposed to the idea of using the destructor for steam raising, or those gentlemen who have the interests of the ratepayers of Burnley at heart. This information shall be forwarded to you as soon as available, duly authenticated.

*For* **Meldrum Bros., Ltd.,**
JAS. MELDRUM, *Director.*

Timperley, *May 18th*, 1904.

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I notice in your issue of May 13th a letter signed by R. Birkett, calling attention to the Burnley refuse destructor.

For many months past I have had sole charge of the destructor, and have yet to receive the first complaint of nuisance from the present plant. There cannot have been any serious "*whiffs of the real article*," or there would certainly have been complaints loud and numerous, especially when we know that the destructor is within 300 yards of the main thoroughfare and commercial centre of this town of nearly 100,000 inhabitants; also that within a radius of 500 yards there are 3,300 dwellings, 300 banks, shops and offices, 73 works, 15 schools, 15 places of worship, the Town Hall, market square, baths, newspaper offices, &c., whilst a high-class residential quarter is at a higher level than our chimney top, and any escape of fumes or dust is readily observable.

I may also say that over 800 ladies and gentlemen from all over the country have visited the works; and I should be pleased to show your representative over the works at any time he may see fit to pay us a visit, although now, and for weeks past, we have been burning much more objectionable matter than usual.

It may be of interest to add that the Health Committee and the Council have unanimously decided to duplicate the present plant, so satisfied are they of its capabilities and freedom from nuisance.

**Joseph B. Massey.**

Burnley Refuse Destructor Works,
*May 18th*, 1904.

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### Frictional Electricity.

There is in this station a portable engine driving an underground countershaft, which again drives an overhead main shaft. The strap driving this is rather long, and is frequently sprinkled with resin, as it is inclined to slip, being a vertical drive. Now, in the hot weather it is possible to get a spark nearly ½ in. long by holding one's fingers near the strap for a few moments, and then touching, or rather just not touching, a convenient earth. This is an eternal source of joy to the native, who believes that I have arranged it for his especial benefit. Can any of your readers tell me if a similar thing occurs in England during the summer?

**Shocks.**

India, *May 6th*, 1904.

[The phenomenon observed by our correspondent is well known to engineers in charge of belt-driven plant.—EDS. ELEC. REV.]

### The Institution of Electrical Engineers.

"Interested's" note struck me as being *very much* interested, and it almost appeared that personal malice was allowed to so run riot as to endanger the signatory's veracity.

Of course, if "Interested" is a bigot, or one who allows his petty spleen to affect his judgement, *he* may think such and such an one is an undesirable, but those who are not so affected, and who probably know more of the qualifications of the elected one, may be of totally diverse opinion. "Interested" presumes he *might* become associated with the Institution, but is not anxious whilst wasters are admitted.

Probably, if "Interested" *tried* to get in the magic circle, he would find it is not so easy a matter to even gain an "associateship"; and, therefore, his presumption is, to say the least of it, just a little bit previous. Then to say he is not anxious to join, because, forsooth, a couple manage to creep in (whether they be what "Interested" suggests or not), whilst, on the other hand, the Institution boasts Kelvin, Thompson, Preece, Marconi, and so on *ad infinitum*, robs, to my mind, his wail, of weight, and, to the members, must seem absurd.

As regards falsifying references, here lies the *venom* of the sting. Now if "Interested" is *not* a member (and proposal forms *are sent to members only*, to propose or otherwise), how comes it that he *knows* the persons referred to falsified their references. I think this is all that need be said. It proves "Interested" to be a twister of truth. "Electro Vital" being a member *has* his remedy, and can use it, if it so concerns him; I refer to Article 38. Let "Interested" and "Electro Vital" come out into the open, and more able pens than mine will take up the cudgels. Are they afraid to sign their names?

**Truth.**

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### Corporation Telephones.

I wish to state that I have found, since the discussion on Mr. A. R. Bennett's paper on "Corporation Telephones," that I made a mistake as to one point in connection with the Glasgow Corporation telephone system. I stated that among the different methods of working there were magneto calling and magneto clearing. I have since learned that this is not so. I very much regret the error.

**Herbert Laws Webb.**

Westminster, S.W., *May 24th*, 1904.

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### Tramway Troubles Ahead.

It is not many months ago since a large town went through one of those very undesirable experiences—a strike. It ended unfortunately for the Corporation, which was several hundreds of pounds to the bad, neglecting such items as disorganisation of the system, causing of bitterness, &c.

Now it is no use being blind to the conditions which at present exist, and are slowly but surely gaining strength, and these are the just grievances of motormen and conductors regarding the vital and serious question of a commonsense working day. At the present time they work under conditions of a split turn system, in which a man comes on duty twice to do a day's work. The objections to this arrangement are seen at once; in it is involved the time wasted in coming on and going off duty twice, also the fact that it breaks into hours which could otherwise be used for recreation, improvement, &c., and other side issues are also involved. Only this week there has been a meeting of tramway workers, who have made an emphatic protest against such conditions. This is fast becoming a grievance of undoubted magnitude; and sooner or later some Corporations will probably be undergoing undesirable experiences, which, needless to say, will be to their financial loss. A great many tramway managers have had little or no experience in the gentle art of handling large bodies of men, which is the strength and keynote of any successful organisation. Now, are tramway managers ready to heed a word of warning?

They can take it as being reliable information that the tramway men's union is fast becoming one of great strength both in regard to numbers and financially, and that before long it will endeavour to force an issue. Instead of their being dictated to by a comparative few, it will be a case of the men doing the dictating. Some tramway managers are already anticipating trouble under this heading, for the reason that they have on their staff dozens of men who are being paid not to drive cars as motormen, but are being kept ready as trained men in the event of a strike. Now, this is a useless waste of money, because these tramway managers are unaware that nearly all of these men belong to the union, and are working in harmony with the regular motormen and conductors. A motorman's place is not easily and quickly filled, as when human lives are at stake, an experienced and well qualified pilot must be at the controller handle. Consider what it would mean for a strike to occur on the systems of, say, Manchester, Liverpool, or Glasgow.

There is a grave situation growing and maturing, and tramway authorities must be prepared to make some common-sense concessions.

**Wm. R. Bowker.**

*May 20th*, 1904.

## REVIEWS.

*The Dynamo.* By C. C. HAWKINS and F. WALLIS. London: Whittaker & Co. 1903. Third edition.

The third edition of this work has been considerably enlarged, and to some extent re-written to meet the remarkable advance in dynamo design, which has taken place since the issue of the second edition in 1893. The authors' introductory remarks are admirably brief. The total number of pages in the book is 914, and the introductory remarks, which are themselves of some interest, consist of nine pages of letterpress, and one picture of Faraday's original dynamo. The book, which contains 26 chapters, is devoted entirely to the consideration of direct and alternating-current generators, motors receiving only casual mention.

The chapters on magnetism deal with the subject in the usual manner. Among the curves, one giving the relation of $\mu$ and B brings out very clearly the rise of $\mu$ at the lower values of B, and its subsequent fall as B increases. A curve of this form, or a B H curve derived from it, should be useful to designers of transformers and alternate-current motors. Another useful curve is one showing hysteresis loss in a rotating, as distinguished from an alternating, field, based upon the researches of Mr. Bailey, Prof. Ewing and others.

Self-induction is explained in a remarkably lucid manner, the explanation being accompanied by diagrams. One set of diagrams shows the relationship of impressed, self-induced, and resultant E.M.F., when the current does not describe a sine curve, and a second set shows how much simpler the problem becomes when a sine curve is assumed.

In the chapter on "Production of E.M.F.," the authors show that placing a conductor obliquely across the magnetic field (with the mistaken idea of increasing its "length") does not produce any increase of E.M.F., as the number of lines cut per second is equal to the virtual area swept through by the moving conductor, when its length and its velocity are projected on a plane perpendicular to the field. It is not uncommon to find in text-books that E.M.F. is given as proportional to length of conductor, and this loose statement has sometimes led to the wrong idea that the E.M.F. of an armature can be increased by laying the conductor obliquely across its face instead of straight.

On the subject of continuous-current armatures, the authors give descriptions of the present methods of construction and winding, as well as methods which are now obsolete. Equalising connections, which have come into use comparatively recently, receive some mention, but the reader is referred to Prof. Arnold's work for fuller information concerning them.

On armature reaction, diagrams are given showing the difference in field distortion obtained with toothed armatures as compared with smooth-cored armatures. For the prevention of sparking, the authors adopt Mr. Hobart's method of so proportioning the armature and its winding that the reactance voltage in the short-circuited coil does not exceed such amount as has been found by experience to give sparkless collection, although they prefer to regard the reversal of current as taking place along a straight line instead of following a sine curve, so that their value of reactance voltage does not coincide with Mr. Hobart's. It appears to us that, for close designing, it is not sufficient to deal with reactance voltage alone, but that the other fields tending to increase or diminish sparking, should be taken into account.

In a chapter on continuous current design, details are given of the design in detail of a small two-pole dynamo with smooth armature and a four-pole dynamo with toothed armature. In this chapter various methods of dynamo testing are also dealt with, including the retardation method. The chapters on continuous-current work conclude with one on the working and management of dynamos.

After two chapters in the earlier portion of the book, of an introductory character, describing heteropolar and homopolar alternators, in which diagrams of some rather curious designs are given, there is a chapter on armature windings of alternators, in which diagrams are given showing the present methods of winding for one, two, and three-phase work, examples of divided and undivided coils being included. In this chapter there is also a very useful table giving the values of K for different ratios of coil-width and pole-width to pitch when the fringe of the field is taken into account, this being taken from the article which Mr. Hawkins contributed to the ELEC. REV., Vol. xlvii., p. 655, and armature reaction in both single and polyphase machines is very fully treated.

Under alternator design an example is given of the calculation for a 488-KW. three-phase generator. In treating of the parallel running of alternators, the method of calculating the correct weight of fly-wheel for a stated phase displacement is given, and M. Leblanc's amortisseur winding is also described.

In addition to the chapter to which we have referred, there are others on mechanical construction and the description of typical dynamos, and the book is illustrated with a number of sectional drawings and photographs.

We may say, in conclusion, that the work is a valuable one, and should be in the hands of all who are interested in the construction of generating plant.

C.W.H.

*Wireless Telegraphy.* By CHARLES HENRY SEWALL. London: Crosby Lockwood & Son; New York: D. Van Nostrand Co. Price 10s. 6d. net.

This book sets out to describe the "origins, development, inventions, and apparatus of wireless telegraphy," and it fulfils its difficult purpose with considerable credit to the author, if not to the publisher. As regards the history of the subject, there is a great deal of available information in the writings of Lodge, S. P. Thompson, and others, from which the author has directly or indirectly profited. In the technical press, and in the newspapers, a vast amount has been written upon this subject, controversially and otherwise, and an author who faces the question fairly has need both of discernment and discretion, in sorting out the facts, and in assigning them to their proper respective origins.

From our reading of this book, Mr. Sewall appears to deal out very even-handed justice. He gives the reader sufficient information to enable him to gather whether Edison, Lodge, or Marconi invented modern wireless telegraphy, and while bestowing on Lodge the palm, he consoles Marconi with honourable mention. Slaby is not given credit for much originality; it is pointed out that he was present with Preece during the Channel experiments, and that he was also present when Marconi gave his famous demonstration in the Bristol Channel. Slaby's subsequent endeavours on similar lines in Germany are therefore chiefly interesting on account of his claims and on account of his having exhibited "his" system before the German Emperor.

Respecting the invention of the coherer, we are left to choose between Père Branly and Prof. Calzecchi Onesti. That is to say, we are told that Prof. Onesti, "about 1886, observed the coherency among metal filings produced by the

impulsive discharge of a previously electrified wire or coil" ; he also discovered that there was a simultaneous change of resistance, and he placed the filings in a tube. Père Branly did much the same thing in 1891. *A propos* of these curious accidents whereby the unthinking public bestow their praise for a new invention upon but one person, and him sometimes the wrong one, the author has some sound things to say, and he deduces an approach to a criterion of what constitutes a "true invention."

The descriptions of apparatus are short ; they are well illustrated, and include recent inventions. There are, however, some important omissions in regard to coherers. The chief interest of this book to the reviewer is the account given of the American patents of Lodge, Marconi, and others, in respect to wireless telegraphy.

If ever the question of priority comes to be fought out in the Law Courts, these will be among the weapons used in the fray, and even at this remote stage we feel rather sorry for the judge. To begin with, there is that remarkable patent of Edison, dated May 23rd, 1885, finally issued December 29th, 1891, numbered 465,971, to which we have before called the attention of our readers. The author informs us that it is reported to have been purchased by the Marconi representatives, and that it has five years to run.

We hope that this book was made, as it was written, in America ; for bad stitching we have seldom seen its equal. It decohered even under the gentle treatment given it in this review.

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*Electro-magnetic Theory.* By S. J. BARNETT, of Stanford University, California. London and New York : Macmillan & Co.

The object of the author of this book, as set forth in his preface, is to present in systematic and definite form, a simple, rigorous, and thoroughly modern introduction to the fundamental principles of electro-magnetic theory, together with some of the more interesting and important non-technical applications of those principles. Systematic, definite, rigorous, and modern, his treatment of the subject certainly is, but its simplicity is so dependent upon the subjective functions and qualities of the mind seeking to master the complexities, that upon this attribute we prefer to express no opinion. It is essentially an academic treatise, a book for the philosopher, and for the engineer who, while realising that the basis of engineering is physics, is fortunate or unfortunate enough to have time to devote to refining the methods of expressing what he ought to know.

By retaining throughout this academic character, Mr. Barnett avoids the pit falls that too often await professors who stray from their schools ; he saves himself the inglorious task of appropriating ancient details from stereotyped text-book sources, and he gives cohesion to a book which would otherwise have fallen into looseness. His indebtedness to Maxwell, Kelvin, Heaviside, Poynting, Gray, Lodge, and Larmor is apparent and admitted ; the references which he frequently gives to the works of these and other writers will be found very valuable to the student. The first two chapters are devoted almost entirely to definitions, and to the discussion of more or less ideal conditions in regard to electrostatic fields. The student is here introduced to "voltivity," "permittivity," and to their product, "displacement"—all expressed in so-called rational units. With these ugly weapons, the struggle begins against tubes of force and converging and diverging vectors.

We admit the rationality of these conceptions, but in striving for simplicity, we would suggest the avoidance of duplicating new terms with old. For example, the student is told, p. 14, that "A line so drawn in an electric field as to have at every point along its length the direction of the electric intensity (electric force), electrisation, or displacement (induction) is called a *line of intensity (force), electrisation, or displacement (induction).*" A statement of this kind almost justifies the existence of the Committee on Nomenclature.

In Chapter III. the author departs from the consideration of concentrated charges and infinite conductors, and treats of finite portions of electric fields, as exemplified by the condenser and electrometer. He afterwards deals with fields containing two or more dielectrics, the reversible thermal effect during electrisation, and with electrostriction. The student is then taught some of the classic methods of determining the permittivities of various media. Chapter VIII. bridges over the gap between the static field and electric currents, by the aid of convection. Ohm's law is carefully defined, and is followed by the usual propositions concerning steady currents. Electrolysis and thermal E.M.Fs. are somewhat briefly handled in Chapters IX. and X.

So far as it is possible to do so, the author follows the same scheme in the treatment of magnetism, and the flux of electro-magnetic energy, as he adopts in regard to electric fields, dealing with each case as it arises as a separate proposition. The result is to divide the book somewhat into watertight compartments ; the advantage of this system in point of clearness and ease of reference fully compensates for the severity and partial discontinuity that it entails.

As the author candidly admits the incompleteness of his treatment of the subject, it would be idle here to indicate what seems to be lacking ; we will content ourselves by expressing the hope that he will extend the work, and that in his next edition he will include some worked examples.

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*The Law Relating to the Telegraph, the Telephone, and the Submarine Cable.* By EVELYN G. M. CARMICHAEL, M.A., Barrister-at-Law. London : Knight & Co. Price 10s. 6d.

The author of this work has supplied what has been a long-felt want in the electrical world, namely, a book which contains and explains the various Statutes relating to telegraphs and telephones. Other works there are which deal with a wider subject, namely, the law relating to electricity ; this is confined to a treatment of a special, but very important, branch of that law.

The author, in his introduction, gives an outline of the history of telegraphs and telephones, taking care to show how it has come about that these are monopolies in the hands of the Government. He reminds his readers that the Act of 1869, which gave to the Postmaster-General the exclusive privilege of conveying telegraphic messages, was passed in the face of a report by a Select Committee that, in their opinion, "it was not desirable that the transmission of messages for the public should become the monopoly of the Post Office" (Parl. Papers, 1868, No. 435).

In the body of the work he has followed the very desirable plan of setting out the text of the various Acts of Parliament, and explaining them by reference to decided cases.

There is one aspect of the science of telegraphy upon which it is interesting to have the learned author's views. In defining the scope and extent of the Postmaster-General's monopoly, Mr. Carmichael says : "The result seems to be that any apparatus for transmitting messages by electric signals is a telegraph, whether a wire is used or not, and that any apparatus of which a wire used for telegraphic communication is an essential part, is a telegraph, whether the communication is made by electricity or not. It includes, on the one hand, electric signals made through the air or the earth, such as the telegraphic system of Marconi ; and on the other, a set of common bells, worked by wires pulled by the hand, if they were so arranged as to constitute a code of signals." This view is probably founded on the judgement of Mr. Justice Stephen in the case of A.T. *v.* Edison Telephone Co., of London (6 Q.B.D. 244), where his Lordship remarked that definition of telegraph in the Telegraph Act, 1869, was probably wide enough to cover every instrument which may ever be invented which employs electricity transmitted *by a wire* as a means for conveying information. Indeed, looking to the extension of the definition inserted in the Act of 1869, the words, "transmitted by a wire," might probably be left out of this definition.

Not the least valuable portion of this work is to be found in the appendices which comprise (*a*) the agreement between the Postmaster-General and the National Telephone Co. as to trunk lines ; (*b*) an agreement between the same parties as to the exchange area of London, which agreement was entered into on November 18th, 1901 ; (*c*) a form of general wayleave agreement ; (*d*) a form of agreement for laying down underground wires, &c. ; (*e*) the Board of Trade regulations as to overhead wires.

A full index completes a work which we can confidently recommend to everyone who desires information with regard to telegraphs and telephones in their legal aspect.

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*Tube, Train, Tram, and Car.* By ARTHUR H. BEAVAN. Published by Geo. Routledge & Sons, Ltd. Price 6s.

This must surely be the book that was being discussed by a couple of newspaper men in the writer's hearing a little while ago: they showed intense appreciation of the way in which their journal had finally reviewed it, though, doubtless, the procedure was decidedly out of the ordinary.

It appeared that the literary editor on receiving the copy had been attracted by the first word in the title of the book, and on the supposition that tubes could only concern the city man, had sent the volume to a friend who dabbled in finance and literature equally unsuccessfully.

This friend chanced to open the book in the middle of a chapter on the startling and perplexed travels of a country damsel on the various London underground lines; and as this neither appealed to his sense of high finance nor philosophic literature, he returned the book to the editor with the remark that the latter ought to get it reviewed by one of his lady contributors.

The editor, however, was a man of resource, and this time dipped more deeply into the book, finding great stores of technical information about electrical lines and the way in which they are worked, and finally sent the book away to an engineering contributor with the feeling that *he* would do it justice.

But alas! the engineer opened the pages at Chapter X., and failed to see what use his great experience of technical matters could be in commenting upon a guide book (even though most interestingly written) to the London tubes, and more particularly the Great Northern, Piccadilly, and Brompton, and he resigned forthwith in favour of the proprietor of *Bradshaw* or Baedeker. He had not time to criticise guide books.

With the book again thrown on his hands the editor allowed it to lie on his desk for a few weeks, until one day a junior reporter asked permission to take it. He came to the office next morning with a quarter column of good and interesting "copy" in the shape of a review, for which the editor blessed him, and the author felt grateful when he read it; while the reporter himself was afterwards heard confessing that he hadn't ever before enjoyed so much the reading of an encyclopædia of information, and that he had learnt such a lot from it that he meant to apply for a conductorship on the L.C.C. tramcars in the hope of eventually rising to the management, and of thereupon combining the whole of the London tubes and tramways into one comprehensive semi-public trust.

Summing up this book, however, in our own words rather than that of other people, it can certainly be said to offer an enormous amount of useful information upon the somewhat varied forms of transit systems embraced in the title. Whether this information would not have been equally useful had it been compressed into one quarter the space, or deprived of all "Family Herald" padding, is a matter for question; but the author has certainly compiled an interesting book that anyone might read with advantage, and especially those who have no great pretensions to technical knowledge. There are plenty of quotations of a polyglot character, but not always correct; for instance, the "descensus" to "avernus" is not "facile." However, we may pardon much in the way of small detail to the author whose book is enlightened by such an H. G. Wellsian frontispiece, and whose other works deal with topics like "Marlborough House and Its Occupants"; "Imperial London"; "Crowning the King," &c.

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## STEAM CURVES.

BY W. H. BOOTH.

MUCH of the misconception which arises in connection with steam engineering problems springs out of the action of steam as an expanding agent. This misconception takes place particularly in reference to the action of superheated steam, its true function being little understood as it pertains to practice, and its idealised function having no practical existence. There are several curves of expansion of steam which may be said to take place under conditions of uniformity, and there are thousands of other curves which are merely accidental curves. These are drawn for us by the indicator, and we speak of them as expansion curves, but they are a mere fortuitous result of the action of a bit of mechanism, and in no sense are they expansion curves, as will later be shown.

Of the true curves there are four recognised. Rankine treats of them all, but his treatment is spoiled by the small consideration allotted by him to the material facts of daily observation, which were in his day given little weight.

The first curve along which steam may be assumed to expand is the common hyperbola, which is a curve such that taking any point in the curve and drawing the ordinate $= y$ to the one axis and the abscissa $x$ to the other—the rectangular hyperbola being in view—the product $x \times y$ is constant for every point, and the curve when referred to pressure, $p$, and volume, $v$, is said to be such that $p \propto v^{-1}$, or $p\,v =$ constant. The common hyperbola is the curve of isothermal expansion of a perfect gas, and superheated steam, expanded *slowly* in a cylinder kept uniformly as hot as the initial steam, will act as a perfect gas and expand along a hyperbolic curve. The expansion would require to be performed slowly, or the expanding steam would not pick up heat from the cylinder quickly enough to maintain itself as hot as the cylinder. This is the highest of the recognised curves of expansion. No true curve ever rises above the hyperbola, for this could only happen where superheated steam expanded slowly in a cylinder heated more highly than the steam. The hyperbola is never even attained in practice as a true expansion curve.

The next curve is one which falls gradually below the hyperbola, and is of such a nature that $p \propto v^{-\frac{16}{17}}$, or otherwise the pressure of the steam varies as the reciprocal of the 16th root of the 17th power of the volume.

This curve, therefore, falls a little below the hyperbola, and it is the curve of expansion of dry saturated steam which receives sufficient heat from an outside source to prevent any portion from liquefying by performance of work. Rankine gives this equation for pressures up to 120 lbs. The curve would be traced approximately if dry steam expanded in a jacketed cylinder. It would not be far departed from where superheated steam, which had expended all its superheat by the time of cut off, continued thence to expand in a jacketed cylinder. It is a curve, therefore, that might be attained in practice.

The adiabatic curve of saturated steam falls still lower than the preceding curve. It is such a curve as is represented by the expression $p \propto v^{-\frac{10}{9}}$, or the pressure at any point varies as the reciprocal of the ninth root of the tenth power of the volume at that point. It is the curve of expansion of saturated steam in the theoretical heat-neutral cylinder. As the steam expands it loses temperature, and part of the heat goes into work, and some of the steam condenses. This curve is impossible of practical attainment, for an adiabatic cylinder is unknown.

The corresponding curve for superheated steam is that in which $p \propto v^{-\gamma}$. Just as for a perfect gas, such as air, the index $\gamma$ is 1·41, so for superheated steam it is 1·3. Thus, while the expansion curve of air is very steep, that for the adiabatic expansion of superheated steam is also steep, but less so than the curve for air. It is an impossible curve in practice, just as is the adiabatic of saturated steam.

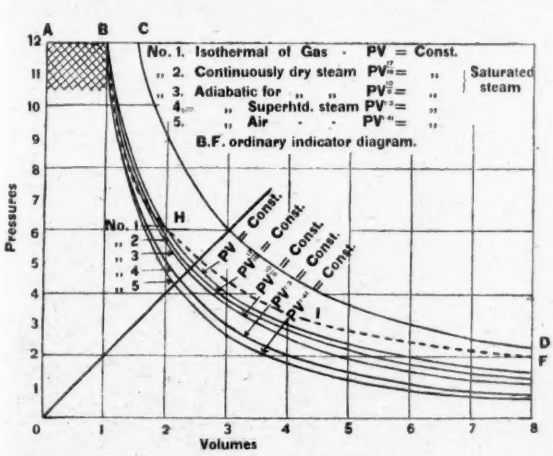
As a simple comparison of the four curves named, in which $p$ varies respectively as $\frac{1}{v}$; $v^{-\frac{16}{17}}$; $v^{-\frac{10}{9}}$ and $v^{-1\cdot3}$, the value of the ratio of the mean to the initial pressure for an expansion of tenfold in each case will be illustrative. The ratios, and their reciprocals, are:—

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| $p\,v =$ const. | $p \propto v^{-\frac{16}{17}}$ | $p \propto v^{-\frac{10}{9}}$ | $p \propto v^{-1\cdot3}$ |
| 3·03<br>·330′ | 3·18<br>·314′ | 3·30<br>·303′ | 3·76<br>·266′ |

These ratios represent the theoretical amounts of work to be expected from a unit weight of steam admitted and expanded, the lower figure giving the work ratio, and the upper figure its reciprocal, or the initial divided by the mean pressure. Thus it is evident that for curve No. 4 the mean pressure is very much less than for any of the other curves, being about 15 per cent. below curve No. 2, which most closely approaches best practical conditions and possibilities. Curve No. 4 is the curve that would be secured if some of the nonsense which is talked about superheated steam could be carried into practice. The use of such an excessive amount of superheat as would carry steam at ordinary cut-off ratios superheated to the exhaust would involve something approaching curve No. 4, and would involve, for an equal amount of work, such a correspondingly extended cut-off as would give a mean pressure ratio equal to that of curve No. 2. All superheated steam is weight for weight of larger volume than saturated steam of equal pressure. The expansion of volume is greater than the increment of heat per volume; hence the fact that per cb. ft. there is less work, because less heat, in superheated than in saturated steam. If it were possible to work superheated steam throughout an engine, the cylinders would require to be larger for the same power, and the losses by radiation from larger surfaces would be also larger. The claim for a thermodynamic superiority of superheated steam is a fallacy that tends to extremes of temperature in practice, and has already led to ridiculous claims being made in respect of superheat that serve only to delay progress, and not to aid it along sound lines. Claims that have been made for superheat of an excessively high degree, have raised the fears of those responsible for steam engines in respect of danger to their valves and packing.

From one extreme they fly to the other, and make believe that with superheaters at the back of the major portion of the heating surface of a water-tube boiler, they can obtain efficient superheat with efficiently worked boilers. No water-tube boiler fitted with an internal superheater has yet given efficient superheat at the same time that the boiler has been worked at an efficient rate of work in respect of its heating surface, and separately fired superheaters are alone fit for use when water-tube boilers are employed.

The large reduction of mean pressure in an engine which would occur if superheat could be carried to exhaust is




EXPANSION CURVES.

well shown in the diagram which bears out the tabular figures above, and is plotted from Rankine's figures for the approximate calculations of steam. The adiabatic curve for steam gas in which $p$ varies as $v^{-1\cdot3}$ has a very steep initial drop.

Of the many curves of actual diagrams, of which the dotted curve may be taken as an illustration, it must be said that they are not true curves, but are merely built up from a single plotting each of a myriad different curves, the pencil being as it were kept in contact with the paper as it passes from point to point.

Thus, in the diagram, while A B represents the initial volume of steam present in the cylinder, the further volume B C has also entered, and has been condensed in heating up the cylinder. The curve C D is the hyperbolic curve drawn from this point C. The final pressure may be at F, showing that there has been some re-evaporation of the water during expansion, but that a further quantity remains for re-evaporation during exhaust.

The actual indicator diagram is B F, a curve which initially drops very quickly, owing to the further condensation after cut-off, and then gradually rises and cuts across all the other curves, owing to the gradual re-evaporation of the water B C.

In a slowly moving engine, well jacketed, the point F would not fall far below the point D. It is obvious that, taking any point in this curve B F lower than the point H, such a point is merely a point in the curve of expansion of an initial volume of steam greater than A B, but less than A C. In passing from H to I, this volume has expanded, and the pressure has been increased by a certain amount of evaporation. Hence the point I is merely a plotting on a fresh curve, and any other point is but a compromise between the expansion at that moment in progress and the re-evaporation that is proceeding. The net result is the curve B F, which begins more steeply than is proper to the volume A B, and ends less steeply than proper to the volume A C. The relation of this curve to curve No. 3 gives the real measure of the action of the steam in the cylinder. The curve No. 1, or the hyperbola, is usually employed as a curve of comparison, simply because it is so easy to draw, but it is considerably out of exactness. The object of using superheated steam should therefore be to prevent the volume B C from entering the cylinder; to start the expansion curve at B with dry saturated steam, and to expand along one of the curves No. 2 or No. 3, along the former if there is an efficient jacket, along the latter if there is no jacket.

If very high superheat were employed, then in place of a weight of steam represented by A B, the actual weight would be less. Hence the rapid drop of pressure along curve No. 4, for the heat per cubic foot is less than with saturated steam. True, there is more heat per pound, but the same poundage of steam cannot be used, and the use of superheated steam would be a mistake, were it not that, by the time the cut-off has taken place, there is no superheat left. But there is also no water left, and the ideal ratio of economy of superheated to saturated steam is the ratio A B to A C in steam consumption.

The curve B F is what has been automatically drawn for engineers for over 100 years. With our present knowledge, it is a curve that calls to us for superheat, and promises economies of 15, 20, and even 30 per cent.; yet it passes unheeded while engineers boggle over an extra 1 per cent. in the mechanical efficiency of an engine, or half of 1 per cent. on a generator output. The ordinary practice of superheating, when attempted by the usual small tube superheaters with frictional effect, reduces the initial pressure of steam in the cylinder by 1 to 1½ atmospheres.

In the diagram this is equivalent to cutting off the shaded upper part of the figure, and is a distinct loss. The area of the pipes of a superheater should be from 1¼ to 1½ times the area of a sufficient boiler steam pipe, so that a maximum drop of 3 lbs. only should occur at the superheater. With these curves of Rankine before his eyes, an engineer can hardly fail to see into the question of superheat better than he has been able to see in their absence.

**Preparation of Magnesium and Zinc Peroxide.**—According to a German patent (No. 151,129, November 28th, 1902) taken out by Dr. F. Hinz, of Berlin, the peroxide of magnesium may be obtained electrolytically in the following manner:—A cell fitted with a porous diaphragm is charged on its anode side with an aqueous solution of magnesium chloride containing about 200 grammes of the crystals per litre, while the cathode compartment is filled with a solution of hydrogen peroxide in which, roughly, the same quantity of magnesium chloride has been dissolved, after its acidity has been removed by adding the necessary amount of magnesium oxide or hydroxide. An electric current of suitable strength is then passed at about 6 or 7 volts pressure between an anode of carbon and a cathode of platinum. A copious separation of peroxide appears at the cathode rapidly; it soon falls into the liquid, and can be collected, washed, and dried at a moderate temperature. It forms an amorphous white powder. Zinc peroxide is obtained in a similar fashion, but the voltage of the current should not exceed 2·5 to 3, or metallic zinc may be thrown down. The peroxides so prepared are of 50 or 60 per cent. strength.

E

## THE REPULSION MOTOR.

By F. W. CARTER, M.A. Cantab.

Until quite recently the continuous-current series motor has met with no serious rival in the field of electric railroading; lately, however, certain commutating alternating current motors have been produced which, it is claimed, possess the characteristics that render the continuous-current series motor pre-eminent for this class of work. The ultimate reason of the superiority of the series motor will be found to lie principally in its drooping speed-torque curve, in virtue of which the motor has a very large reserve of torque capacity, without a correspondingly large reserve of horse-power capacity.

The force required to move a train uniformly on level track will amount, perhaps, to 15 lbs. per ton of dead weight. To start the train, however, with an acceleration of only one mile per hour per second requires a force of about 110 lbs. per ton of dead weight, in addition to that necessary to overcome friction. Thus, to operate such a train the motor must be capable of exerting more than eight times the torque required for uniform motion on a level track.

A motor of practically constant speed—like the induction motor—supplies power in proportion to its torque, but in a motor having a drooping characteristic, the power developed increases with the torque at a much lower rate than proportionality. In the continuous-current series motor, such as is used in railway work, the speed of reaching the speed curve, after acceleration on resistance, will usually be less than half the free-running speed on the level. Thus, while the tractive effort may be more than eight times as great, the power output may be less than four times as great as when running uniformly on level track, and the input will probably be only about three times as great, since the efficiency will be higher at the higher output. And it is not only in starting a train that the advantage of the drooping characteristic is manifest, but every up-grade tells the same tale of smaller input and corresponding smaller power capacity. Nor is it only under the train that the advantage of the smaller necessary power capacity is felt, but the control system, the line equipment, the sub-station system, and the main generating station are all benefited in the same manner and for the same cause; all carry a less reserve than would be necessary but for the drooping characteristic curve of the driving motors.

Another objection to the use of motors running at practically constant speed becomes evident when the driving wheels on different motor axles differ in size. This will cause the load to be very unequally distributed between the motors, those driving the larger wheels taking the heavier load. The fault would naturally appear when the road had been in operation long enough for some of the wheels to be replaced by new ones. This effect is hardly noticeable with a continuous-current railway motor.

Hence experience has proved that it is usually better engineering to adopt the continuous current third-rail system, with its complicated sub-stations, its large currents and excessive loss in low tension feeders and return, than to use high potential alternating current directly to operate the train by means of polyphase induction motors. Nevertheless, the continuous current system is limited in its application to crowded districts in the neighbourhood of big towns, where the density of traffic is sufficient to warrant a large capital expenditure on generating and converting plant and heavy line equipment. There is absolutely no prospect of our main line railways being electrically operated while such a system is the best we can offer. Even the feeders of the trunk lines—fitting subjects for well-engineered electrification schemes, in that a service of small and frequent trains could be economically maintained by electric operation—would not usually pay for working by the continuous current system.

The object of the present article is to discuss the principles and properties of a single-phase alternating current motor whose speed characteristic droops considerably with increase of train resistance, thus fulfilling the prime requirement of a railway motor without sacrificing the advantages of alternating current working.

The repulsion motor is itself a form of induction motor, the currents of the armature being induced by the applied field, in virtue of which they cause a drag on the armature conductors. The field or stator winding resembles that of a single-phase asynchronous motor, whilst the armature or rotor resembles that of a continuous current generator or motor having the same number of poles as the field. The brushes are short-circuited, and set a little distance from the centre of the field poles, on one side or the other, according to the direction of rotation required. It is usual in books dealing with the repulsion motor to state that the shift of the brushes should be 45° (electrical) from the centre of the pole in order to obtain maximum starting torque. This conclusion, however, is founded on fallacious reasoning, the maximum torque occurring when the brushes are only a few degrees (5° or 6°) from the pole centre.

The principle underlying the operation of the motor is old, though I believe their commercial manufacture to be of recent origin—that is, as regards motors intended to *run* as repulsion motors. The repulsion principle, however, has been frequently used as a means of starting single-phase asynchronous motors, the Wagner Electric Manufacturing Co., of St. Louis, U.S.A., having had such a motor on the market for a considerable time. In this motor, when synchronism is reached, an internal mechanism operated by centrifugal force serves to close a ring switch which short-circuits the commutator bars, and to raise the brushes at the same time. The motor then runs as an ordinary induction motor without unnecessary wear of commutator and brushes. The Schüler motor is another example of a single-phase induction motor started by means of the repulsion principle.

In the present article, however, it is intended to deal with the repulsion motor *per se*, to demonstrate and discuss its properties, and to determine what features are desirable for securing satisfactory operation.

(*To be continued.*)

## BUSINESS NOTES.

### Electrical Wares Exported.

Week ending May 26th, 1903.

| | | |
|---|---|---|
| Alexandria | Value | £1,190 |
| Amsterdam | | 30 |
| Bahia | | 50 |
| Bombay | | 164 |
| Brussels | | 17 |
| Buenos Ayres | | 115 |
| Calcutta | | 250 |
| Cape Town | | 572 |
| Colombo | | 58 |
| Durban | | 1,299 |
| East London | | 72 |
| Fremantle | | 21 |
| Gibraltar. Teleg. cable | | 8,120 |
| Gothenburg | | 100 |
| Halifax | | 75 |
| Hamburg. Teleg. mat. | | 270 |
| Hayti. Teleg. cable | | 8,146 |
| Hong Kong | | 25 |
| Lisbon. Teleph. mat. | | 106 |
| Lyttleton | | 50 |
| Malta. Teleg. cable | | 9,340 |
| Melbourne | | 88 |
| ,, Teleg. cable | | 1,360 |
| Montreal | | 63 |
| North Atlantic. Teleg. cable | | 6,060 |
| Otago | | 182 |
| Perim. Teleg. cable | | 12,650 |
| Port Elizabeth | | 4,315 |
| Port Said | | 30 |
| Rotterdam. Teleg. wire | | 45 |
| St. Petersburg. Teleg. wire | | 61 |
| Shanghai | | 386 |
| Singapore | | 11 |
| Stockholm. Teleg. mat. | | 142 |
| Suez | | 175 |
| ,, Teleg. cable | | 15,280 |
| Surinam | | 82 |
| Sydney | | 673 |
| Toronto | | 54 |
| Wellington | | 89 |
| ,, Teleg. mat. | | 322 |
| Yokohama | | 22 |
| Total | | £72,120 |

Week ending May 24th, 1904.

| | | |
|---|---|---|
| Adelaide | Value | £55 |
| Aden. Teleg. mat. | | 150 |
| Amsterdam | | 125 |
| Auckland | | 185 |
| Bilbao | | 37 |
| Bombay | | 860 |
| ,, Teleg. mat. | | 10 |
| Boulogne | | 173 |
| Buenos Ayres | | 111 |
| ,, Elec. machinery | | 2,500 |
| ,, Teleg. cable | | 78 |
| ,, Teleg. mat. | | 1,563 |
| Calcutta | | 662 |
| ,, Teleg. mat. | | 362 |
| Callao. Submarine cable | | 3,605 |
| Cape Town | | 155 |
| ,, Teleg. mat. | | 84 |
| Channel Islands | | 53 |
| Colombo | | 99 |
| Constantinople | | 307 |
| Copenhagen. Teleg. mat. | | 605 |
| Delagoa Bay | | 210 |
| Durban | | 832 |
| ,, Teleg. mat. | | 1,580 |
| Hamburg | | 199 |
| ,, Teleg. mat. | | 300 |
| Hong Kong | | 115 |
| Invercargill | | 150 |
| Launceston | | 230 |
| Madras | | 520 |
| Melbourne. Elec. machinery | | 360 |
| ,, Teleg. mat. | | 450 |
| ,, Teleph. cable | | 702 |
| Mombassa | | 69 |
| Montreal | | 16 |
| Nagasaki | | 284 |
| Ostend | | 25 |
| Penang | | 186 |
| Pernambuco | | 42 |
| Port Elizabeth | | 31 |
| Shanghai | | 214 |
| Singapore | | 28 |
| Sydney | | 523 |
| ,, Teleph. cable | | 142 |
| Tokio | | 78 |
| Toronto | | 10 |
| Wellington | | 187 |
| Yokohama | | 180 |
| Total | | £19,792 |

### Foreign Goods Transhipped.

| | | |
|---|---|---|
| East London. Elec. goods | Value | £115 |
| Sydney. Elec. lamps | | 32 |
| Total | | £147 |

| | | |
|---|---|---|
| Boulogne. Elec. meters | Value | £73 |
| Durban. Teleph. mat. | | 375 |
| East London. Elec. goods | | 26 |
| Melbourne. Elec. lamps | | 58 |
| Progresso. Telephones | | 289 |
| Sydney. Elec. lamps | | 60 |
| Total | | £876 |

**Belgium.**—The balance-sheet of La Société Metallurgique de l'Aluminium (Procédés Peniakoff), of Brussels, for the last financial year shows a loss of £1,248.

**Brush Contracts.**—The Brush Electrical Engineering Co., Ltd., have secured the following contracts:—

Rangoon Port Trust.—Complete generating and motor plant for electrical equipment of workshops.
Hollymoore Asylum.—Motor equipment for laundry.

**"Patrick" Metal.**—A new metal is being placed on the market by Messrs. J. C. Lyell & Co., Ltd., of 55, Victoria Street, S.W., viz., "Patrick" metal, which is a perfect substitute for nickel, being silver white through and through. We have received from them a sample of this metal, in three stages of finish; it appears exactly like yellow brass except in colour. Some of the advantages claimed for "Patrick" metal are as follows:—It retains its silver white appearance permanently, whereas nickel-plated goods soon become spotted by damp and lose their brilliancy. The colour is not affected by usage, in fact, the more it is used the brighter it becomes. It retains a very high degree of polish, and with ordinary care will not rust, even under the most unfavourable conditions. It does not easily oxidise. It is malleable to a degree when cold, and can be easily soldered and brazed, the flux for this metal being the ordinary soldering fluid or powdered borax. "Patrick" metal is supplied in the rough state in ingot only for casting purposes, and in the finished state in fittings of every description.

**The Transvaal.**—The value of the electric cables, wires, and fittings imported into the Transvaal during January last, is officially returned at £9,000, as compared with only £4,000 in the corresponding month of 1903.

**Deptford Town Hall.**—The B.C. on Tuesday decided to ask Messrs. Drake & Gorham, Ltd., the contractors for the electric lighting of the new Town Hall, to give a price for the wiring work in connection with internal telephones and bells. Messrs. Medhurst and Lloyd estimate the cost at £150.

**Imports of Foreign Electrical Machinery.**—Although slightly in excess of those in the same month of last year, the imports of foreign electrical machinery into this country during April last were not up to recent averages. The imports during the month named were valued at £39,588, as against £43,432 in March last, and £38,768 in April, 1903. For the first four months of the year the returns show a total of only £178,924, which contrasts with £223,039 in the corresponding period of last year.

**The Ventilation of Transformers.**—Nearly everyone who has been engaged in electrical distribution employing transformers has been met with the difficulty of ventilating adequately such transformers when they are enclosed in water-tight cases, for use in underground sub-stations, which are liable to flooding; and has also experienced the difficulty of removing the water of manufacture left in the transformers unless one left the lid open, thus doing away with the water-tight quality of the enclosing case. These very real difficulties have now been overcome by an invention for which patent rights have been sought, which allows, by the use of discriminating valves fixed to the case or tank containing the transformer, a continual supply of air to enter and leave the tank, and, at the same time, allows all the water of manufacture, which condenses on the under-side of the cover, to run out of the enclosing tank, the cover being formed in such a way that the water cannot remain inside. Fitted with these valves, a transformer can be left with perfect safety in a sub-station likely at any time to be flooded; even if the water rises completely over the transformer, none can enter the case, and as soon as the water is drained away or removed, ventilation is at once automatically resumed. The same device may be used in connection with fan motors for the ventilation of mines and ships' holds, and can be fixed to any existing patterns of transformer tanks. Mr. L. R. Lee, of the Manchester Corporation electricity works, is the inventor and owner of the appliance.

**New Form of Motor-Starting Panel.**—Messrs. Geipel and Lange are introducing a new form of motor-starting panel, of the Ward-Leonard type, incorporating their latest improvements. An illustration before us shows that this panel carries one D.P. switch, two S.P. fuses, one motor-starter and one field rheostat. The motor-starter is of the S.K. "fool-proof" type, which is fitted with a release that opens the circuit-breaker independently of the contact arm, and thus prevents the resistance being cut out too rapidly. This circuit-breaker opens also at any time whilst the motor is running should the current become excessive, thus affording protection against carelessness and ignorance, as well as accidental overload. We understand that consulting engineers in this country frequently specify that a certain amount of speed regulation shall be obtained on the motor by means of the fields, and this particular type of panel is arranged so that the field rheostat, which is connected to the field of the motor, shall introduce sufficient resistance step by step over 35 contacts to cause the required acceleration. In order that the motor shall not be started up whilst the field is not fully excited, owing to the resistance having been left in circuit accidentally, an interlocking lever is provided, by means of which the starting arm is prevented from moving until all the resistance is cut out of the field. The Ward-Leonard Co. (whose agents are Messrs. Geipel & Lange, of 72a, St. Thomas Street, S.E.) have also standardised a number of other patterns of rheostat panels.

**The "Diamond H" Switch.**—In response to the steadily increasing demand for a thoroughly high grade electrical switch in this country, the Hart Manufacturing Co., of Hartford, Conn., U.S.A., manufacturers of the "Diamond H" switch, have recently opened a branch office at 25, Victoria Street, Westminster,

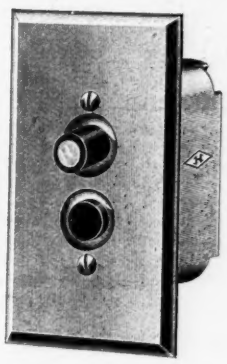


Fig. 1.

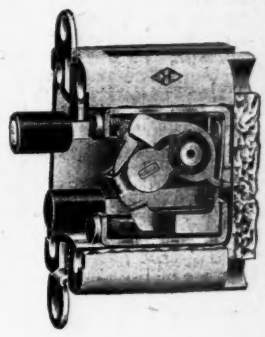


Fig. 2.

under the management of Mr. William Crichton, the secretary of the company, for the purpose of placing their specialities within the easy reach of those contemplating high class installations. This company operates under the patents of its president, Gerald W. Hart, whose experience as inventor and manufacturer of switches and accessories, covering a period of many years, has placed its product pre-eminently at the head of the list of such appliances in the United States.

Prominent among the distinctive features of these switches, as compared with those in general use in England, is that they are

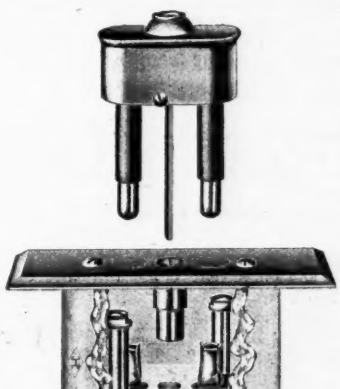


Fig. 3.—Plug Out, Apertures Closed.

sunk into the wall, the metal plates being flush. These plates may be of any finish desired, gold, silver, bronze, &c., in their various gradations, being usually made to correspond with the other fittings of the room, thus giving a most ornamental and artistic appearance, and dispensing with awkward and unsightly projections. The action is absolutely positive and instantaneous, thus eliminating dangers due

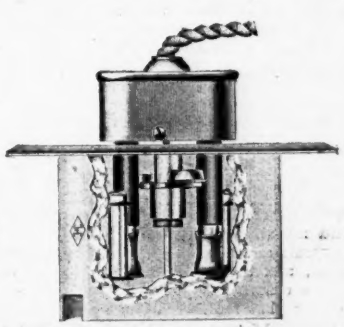


Fig. 4.—Plug in Place.

to arcing in the contacts, and consequent destruction of the switch, if not more serious damage; the working parts subjected to greatest wear are made from case-hardened and tempered tool steel, the knife contacts of phosphor-bronze, and the current-carrying parts are insulated from the switch mechanism with India sheet mica.

In England a number of important installations have already been fitted, notably, one at the Midland Hotel, in Manchester. In the United States, where this type of switch is practically universal, it is recognised as the standard of excellence, being in use at the Presidential Mansion at Washington, as well as in many of the large structures, Governmental and private, in the capital and other principal cities.

The push-button switch is the switch *par excellence* for work of the highest grade. It is operated by means of two small buttons; pressing the white one turns the light on, while the black one breaks the circuit, and turns it off. The buttons are readily distinguishable; one may be of pearl or ivory, the other of hard rubber or ebony. The push switch is illustrated herewith, in elevation, fig. 1, and in section, fig. 2.

A novelty recently placed upon the market by this company, is a flush receptacle, with automatically closing apertures; it may be sunk in the base boards or floor of a room, and as it is flush it cannot be injured by contact with furniture, &c. The action of this mechanism is most ingenious, and constitutes a radical departure from anything in use, either here or elsewhere, for a similar purpose. Figs. 3 and 4 show the receptacle and plug in the open and closed positions.

Illustrated catalogues and all other information may be obtained at the company's offices at 25, Victoria Street, S.W.

**Ferranti Alternating Current Meter.** — We are pleased to learn that this new watt-hour meter, which was described in our issue of January 1st, 1904, has now received the official approval of the Board of Trade.

**Bankruptcy Proceedings.**—The adjourned first meeting of creditors under the failure of Charles Manners Downie, trading as the Lighting Corporation, at 4, Bloomsbury Street, and 15, Dyott Street, New Oxford Street, W.C., was held last week at the London Bankruptcy Court, before Mr. E. Leadam Hough, senior Official Receiver. The statement of affairs shows gross liabilities £1,826 11s. 6d., of which £1,595 9s. 9d. is expected to rank, against net assets £349 4s. 8d., after allowing £181 0s. 5d. for the preferential claims. In the absence of a satisfactory offer, a resolution was passed for Mr. C. J. Singleton, chartered accountant, 8, Staple Inn, W.C., to act as trustee and administer the estate in bankruptcy, assisted by a committee of inspection. The public examination of the debtor has been appointed for June 9th.

The first meeting and public examination in the case of William Wenham, electrical engineer, of Croydon, are to be held on June 3rd and 29th respectively, the former at 24, Railway Approach, S.E., and the latter at Croydon.

**Dissolutions and Liquidations.**—The following further notes relate to the liquidation proceedings of the Automatic Telephone Co., and should be read in continuation of what appeared in our last issue:—

"Meanwhile, the liquidator of the Apostoloff Syndicate was pressing for settlement of a claim he had made against the company, and, with a view to settling this claim, and to provide the money to manufacture the telephone exchange on a commercial scale, Mr. Margowski induced the shareholders, in December, 1902, to agree to another reconstruction. The old company accordingly went into voluntary liquidation, with Lieut. E. G. Testing, R.N., the secretary, as liquidator. The present company was registered with a nominal capital of £100,000, divided into 47,940 preference and 752,060 ordinary shares of 2s. 6d. each. It appeared that, so far from Mr. Margowski's powers being in any way reduced, as was desired by the shareholders, they were apparently increased under the articles of the reconstructed company. Under an agreement which the new company entered into with the liquidator of the old company, the new company took over the assets, and indemnified the liquidator against the liabilities; it also undertook to allot to the shareholders of the old company two shares, credited with 2s. paid, for every share of the old company. The number of shares issued was 558,662 ordinary and 4,000 preference, credited with 2s. paid, and 1,800 were issued as fully paid. The circumstances under which those 1,800 shares were issued as fully paid would have to be inquired into. The signatories appointed Dr. H. G. Sworn as a director to act with Mr. Margowski, and, according to the register of directors filed at Somerset House, Mrs. Dora Margowski was appointed a temporary director on February 1st, 1904, upon her own nomination, under special powers given to her by the articles of association, as holder of the majority of the preference shares. As soon as the new company was registered, Mr. Margowski purchased certain plant and machinery for the purpose of manufacturing telephone exchanges, and erected it on premises at the rear of 72 and 74, London Street, Greenwich. Work was carried on there for a short time, but one by one the staff were dismissed. Subsequently Mr. Margowski, acting alone, purported to pass the following resolution: "Resolved that the company purchase a one-half interest in the British patent rights of the portable electrical ventilating fan for £950, and until the money be paid the company hereby charges its entire plant and machinery, and undertakes at any time when called upon to execute any proper document for the due fulfilment of this resolution, and to register such document at Somerset House, either as a charge or mortgage on the above plant and machinery." Under that resolution was written the date October 28th, 1903, a significant date seeing that on November 4th a receiving order in bankruptcy was made against Mr. Margowski. Then on November 11th Mr. Margowski applied, as agent for a German inventor, for provisional protection for an invention for a portable electrical fan, and on November 18th he applied on his own behalf for a similar protection for an improved fan. The following day the registered offices of the company were removed to Greenwich, a distress having been levied on the premises of the Honduras Co. in Abchurch Lane, which had, until then, been used as the registered offices of this company. That provisional protection was returned in the statement of affairs as an asset worth £3,000. Some of the shareholders became very dissatisfied with the position, and a petition was presented upon which the winding order was made. Mr. Margowski called a meeting to pass a resolution for voluntary liquidation, but the proceedings thereat appeared to be most irregular. The plant and machinery were claimed by Mrs. Margowski, under what purported to be a mortgage, and an arrangement had been made for the property to be sold under the joint instructions of that lady and the Official Receiver, and for the proceeds to be paid into a joint account pending the decision of the Court being obtained as to the validity of the mortgage. The amount actually received by the company was only £5,320, of which £3,150 which was paid in by Mr. Margowski on account of his share liability was handed back to him by the liquidator in satisfaction of a claim of £5,000 which Mr. Margowski asserted that he had against the company, but so far as the Official Receiver had ascertained, it did not appear that there was any foundation whatever for it. A sum of £6,474 should have been received under the reconstruction scheme from Mrs. Margowski, the Honduras Co, and two friends of Mr. Margowski, but they dissented from the scheme, and it was arranged that instead of contributing the 6d. per share on their holdings, they should be allotted only four-fifths of the number of the shares held by them in the old company. It therefore appeared that Mr. Margowski's friends whilst benefiting very largely by the reconstruction scheme, for they held 212,000 shares, were relieved from contributing anything towards the expenses. It further appeared that at the present time the company did not possess one of the patents, which for the purpose of working it was reconstructed, and the only asset it had to show for the £3,250 subscribed was the machinery at Greenwich, which was claimed by Mrs. Margowski under her mortgage, and which she valued at £500. Mr. Margowski had stated that he had received £3,186, and had spent £3,256 on behalf of the company, as follows:—

| | | | |
|---|---|---|---|
| Plant, machinery, and furniture | £892 | 12 | 4 |
| Preliminary expenses | 185 | 0 | 0 |
| Managing director's salary | 541 | 13 | 4 |
| Directors' fees | 113 | 0 | 0 |
| Managing director's travelling expenses | 105 | 9 | 5 |
| Ditto, petty expenses | 279 | 7 | 9 |
| Payments for the company | 13 | 0 | 0 |
| Salaries and wages | 458 | 17 | 0 |
| Stationery, advertising, &c. | 54 | 4 | 5 |
| Clerical work | 20 | 0 | 0 |
| Patent agent's fees | 136 | 0 | 0 |
| Rent | 410 | 0 | 0 |
| Sundry payments | 16 | 16 | 5 |
| On account of law costs | 20 | 0 | 0 |

Dr. Sworn had stated that he had received no directors' fees. It was hardly necessary to add that there were many facts in connection with this company and its predecessors which required investigation, and he did not think he was going too far to say that it would probably be necessary to apply to the Court for a sitting for the public examination of the persons concerned.—Mr. Barry Cohen, on behalf of shareholders, emphasised the necessity for a public examination, and hoped that steps would be taken with a view to recovering some of the £3,000 from Mr. Margowski.—A resolution was passed for the official receiver to remain in charge of the liquidation, with a committee of inspection to be subsequently appointed by the Court.

A dissolution of partnership is announced between Eugene Morand and Arthur Walter Curtis, electrical engineers, trading as Curtis and Morand, at 95, Station Street, Birmingham.

Messrs. S. Haynes & Co. (S. Haynes & A. E. Farell) electrical and gas fittings merchants, Dick's Yard, Nottingham, have dissolved partnership from May 16th. Mr. Farell will carry on the business of S. Haynes & Co., and discharge all liabilities; and Mr. S. Haynes is opening a wholesome electrical supply stores at Pearson's Buildings, St. James's Street, Nottingham.

A meeting of the Hiram Maxim Lamp Co. is to be held at 3, Lothbury, E.C., on June 30th, to hear an account of the winding up from the liquidator (Mr. W. B. Peat).

A meeting of the Electrical Copper Co. is to be held on June 29th, at Winchester House, to hear an account of the winding up from the liquidator.

**The Printing Trades Exhibition.**—We understand that at the recent Agricultural Hall Printing Trades Exhibition, Messrs. J. H. Holmes & Co. had several of their Lundell motors in use working printing presses. One motor was used geared direct on to D.D. summit machine fixed and running complete with Holmes-Page automatic starter, D.P. and regulating switches, at Messrs. Salmon & Sons' stand; at the same stand there was a motor with pinion, wheel and bracket, also switches driving Q C. folder, and a motor driving by belt a 33-in. cutting machine, complete with starter and D.P. switch. At Messrs. Charlesworth and Co.'s stand there was a Lundell motor with starter, D.P. switch, also regulating switch, geared direct to a D.C. litho. At the exhibit of Messrs. W. Crossland, Ltd., there was a Lundell motor with switches to drive countershafting by belt. The following were shown at the stand of Messrs. Hunters, Ltd.:—One motor, fitted with pulley and provided with sliding rails, also switches, driving a two-revolution press by belt; one ditto, mounted on clamping base with grooved pulley, to drive a Model printing machine; one ditto, with switches, driving a bronsing machine by belt; one ditto, complete with rails, pulley, starter and D.P. switch, driving a Cropper machine.

**Chinese Patents and Trade Marks.**—Messrs. W. P. Thompson & Co., the well-known patent agents, write as follows:—In the treaty which has just been ratified between the United States and China, there is the following clause which, through the

most favoured nation clause of the treaty of Tientsin, is equally applicable to Great Britain, the words "Great Britain" being substituted for the United States in the clause.

The United States Government allows subjects of China to patent their inventions in the United States and protects them in the use and ownership of such patents. The Government of China now agrees that it will establish a Patent Office. After this office has been established and especial laws with regard to inventions have been adopted it will thereupon, after the payment of the prescribed fees, issue certificates of protection, valid for a fixed term of years, to citizens of the United States on all their patents issued by the United States in respect of articles, the sale of which is lawful in China, which do not infringe on previous inventions of Chinese subjects, in the same manner as patents are to be issued to subjects of China.

An inquiry has been made by His Majesty's Minister at Pekin whether the Chinese Government have taken any steps to establish a Patent Office as provided in Article 10 of the American Treaty, but the reply has not yet been obtained.

Hitherto China has been dead against patents of all kinds, and the history of China and Japan are remarkable instances of the advantages and disadvantages of a patent law. In China and in Japan, until a patent law was established, invention stopped at the point at which it was no longer profitable to an individual to invent, as he could not keep the matter secret. In matters of manufacture, the Chinese and Japanese recipes for compositions had nearly reached perfection, but anything which could not be worked without the public being able to at once copy, was not invented. Japan passed a very liberal patent law about 20 years ago, and its progress since then has been phenomenal—while China equally civilised has stagnated. The present Chinese Government, however, are now convinced that they must go in for modern improvements, hence this patent law.

In the British Treaty with China, signed at Shanghai, September 5th, 1902, is the following article in regard to trade marks:—

Inasmuch as the British Government afford protection to Chinese trade marks against infringement, imitation, or colourable imitation by British subjects, the Chinese Government undertake to afford protection to British trade marks against infringement, imitation, or colourable imitation by Chinese subjects.

The Chinese Government further undertake that the superintendents of Northern and of Southern trade shall establish offices within their respective jurisdictions under control of the Imperial Maritime Customs where foreign trade marks may be registered on payment of a reasonable fee.

Substantially, this article has been reproduced in the United States Treaty. Through the kindness of the Marquis of Lansdowne we have received the following information:—A working scheme for patent and trade mark protection is now being evolved, and in the meantime a provisional registration office for trade marks has been established at the Custom House at Shanghai, where we have a registration agent, and the Chinese Courts will presumably afford, as they have done in the past, substantial protection against counterfeiting trade marks on the part of Chinese subjects. The French, Italian, German, and English representatives have mutually arranged for the punishment in the Consulate Courts of France, Germany, Italy, and England of subjects of these countries who infringe registered trade marks, and in all probability the remaining Western Nations will shortly do likewise."

**Catalogues and Lists.**—From Messrs. Mather and Platt, Ltd., we have received copies of the second edition of their high lift turbine pump catalogue, and the seventh edition of their catalogue relating to steel-clad motors. The former contains general description with head and efficiency curves, and tables of dimensions, weights, capacities, outputs, and prices; one of the tables particularises the pumps direct coupled to steel-clad motors. The latter gives some information and useful tables relating to their different classes of motors of the steel-clad type, and motor starting and regulating switches. Both lists are as usual excellently laid out. The same company is supplying cast-iron tanks from stock, and details of these can be found in a third pamphlet which has just been issued from the press.

The British Westinghouse Co.'s latest pamphlet to hand (No. B 1,072), describes the company's No. 90 M tramcar controller.

Messrs. W. E. Burnand & Co., of Lowfield Works, Sheffield, have issued a 12 pp. circular relating to their patent alternating-current motors.

Some attractively got-up pamphlets have been sent to us by Messrs. A. Heinz & Cie., of Levallois (Seine). One details their batteries for electric vehicle and other portable service, and the others give information of secondary batteries for stationary service, and an account of the component parts, and their manufacture.

Messrs. Sessions & Sons, Ltd., of Gloucester, have sent us a price list of their electrical slabs in plain and enamelled slate.

We have received from the Isca Foundry and Engineering Co., of Newport (Mon.), a sheet of illustrations of some of their specialities in railway plant. Steel castings, tramway points and crossings, railway signals, cranes, turntables, portable railways, cast-iron pipes, &c., are shown.

The electricity department of the Borough of Hackney is issuing a well illustrated and printed pamphlet giving details of the application of electricity to lighting, heating, cooking, &c. Lists of the streets in which a supply is available, names of wiring contractors, details of first and subsequent cost of apparatus, and numerous testimonials from satisfied consumers, are included in the 59 pages of matter which it contains.

**Automatic Fire Alarms.**—The May-Oatway Fire Appliances, Ltd., of Glasgow, is putting in an extensive installation of its system for Messrs. J. & P. Coats, Ltd. The system is to serve some 60 buildings, most of which are already sprinklered. The installation will require 18 automatic telegraphs, and the central fire station equipment will be as extensive as any in Scotland, with the single exception of Glasgow.

**Tramway Point Controllers.**—Messrs. S. Dixon & Son, Ltd., Leeds, have installed one of Turner's patent automatic tramway point controllers at the Market Street junction of the Bradford city tramways. This was one of the features inspected by the municipal tramway managers on the occasion of their annual conference at Bradford on 13th and 14th inst. Upwards of 60 cars per hour pass over this junction.

**Motor Contract.**—The British Electric Plant Co., Ltd., of Alloa, have just received from the Central Marine Engineering Co., of West Hartlepool, an order for the whole of their present requirements of motors for driving their machine shops. The order comprises 28 direct current motors ranging from 8 to 62 H.P., and aggregating over 900 H.P. The majority are very slow-speed motors, and almost all are back-geared. The contractors for installing this plant are Messrs. Selby-Bigge & Co., of Newcastle.

**Trade Announcements.**—Messrs. Green & Boulding have opened new premises and showrooms at 28, New Bridge Street, and Little Water Lane, Queen Victoria Street, E.C., where all communications should in future be sent.

Messrs. Bruce Peebles & Co., Ltd., of East Pilton, Edinburgh, announce that owing to increasing business they have removed their London office to more commodious premises, at 25, Victoria Street, S.W., to which place all correspondence should in future be addressed.

Messrs. Fuller Macleod & Co., Ltd., inform us that they have been appointed sole British agents for Hellesens Enke & V. Ludvigsen, whose dry cells are well known. Messrs. Hellesens' dry cells have excellent keeping properties, as an instance of which it may be stated that several Governments, who use the cells for torpedo work, keep them in store for five or six years.

**Book Notices.**—"Annual Catalogue of the Massachusetts Institute of Technology for 1903-4." Boston, Mass.: The Institute.

"Report of the Council to the Members of the City and Guilds of London Institute for 1904" and "Programme of the City and Guilds Central Technical College." London: Gresham College, E.C.

Messrs. E. & F. N. Spon will in a few days issue a new book by Wm. R. Bowker, on the "Management of Electric Tramways and Light Railways."

"A Text-book on Static Electricity." By Hobart Mason. New York: McGraw Publishing Co. $2.00.

**Pulford Bros., Ltd.**—This company of electrical engineers doing business at Whitechapel, Liverpool, held its sixth annual general meeting on 20th inst. We are informed that the managing directors reported that the business for the year had been of a very favourable character, and the directors, after providing for depreciation and bad debts, recommended the payment of a dividend for the year ended March 31st, of 15 per cent., free of income-tax, carrying forward the balance of profit and loss to reserve account.

**Raworth's Traction Patents.**—The Electric Tramways Co. of Havre has given an order for a car to be fitted with automatic regenerative control. This makes a total of eight tramway proprietors that have decided to introduce the system. The Havre company works a gradient of 1 in 10, 1,100 metres in length.

## LIGHTING AND POWER NOTES.

**Abram.**—The U.D.C. is negotiating with the Lancashire Electric Power Co. for a supply of energy.

**Ashton-under-Lyne.**—The T.C. has offered to light the markets at the following rates:—65 existing lamps, £14 each per annum; 15 enclosed arc lamps up to 11 p.m., £9 each; 18 enclosed arc lamps all night, £15 each.

**Austria.**—A project for the establishment of an electric lighting and power station in the Reichenberg district has been decided upon. The area includes about 100 sq. miles, and 24 townships have subscribed to the capital stock. The population of the district is 60,000, and the amount subscribed £40,000, which it is proposed to increase to £80,000.

**Barking.**—It is estimated that a net profit of about £250 will be shown as the result of the past year's working of the E.L. undertaking. A new power station is to be erected on a riverside site, generating 3-phase current at 6,000 volts.

**Benwell.**—The U.D.C. has resolved to apply to the L.G.B. for sanction to a loan of £5,000 for the purpose of laying cables for electric lighting in the district.

**Birmingham.**—The Electric Supply Committee of the C.C. reports that the units sold during the year amounted to 4,367,164, and the revenue to £69,421, as compared with 3,737,419 and £67,695 in the previous year. The small increase in revenue as compared with output was due to the reduction in price. Had the charges remained at the old figure, the revenue would have amounted to £77,476. There is a credit balance of £36,939 as compared with £30,593 for the previous year, and the total costs of production were 1·742d. per unit as against 2·097d. The result of the year's working, after paying interest and sinking fund charges amounting to £26,527, is a surplus of £10,412. This amount has been carried to the statutory reserve fund, bringing it up to £37,613. During the year just ended, some 10,051 yards of additional mains and the equivalent of 12,500 16-C.P. lamps have been added.

**Blackburn.**—The electrical engineer's report on the last year's working of the electricity undertaking to March 25th last, shows that the receipts amounted to £28,550, and the total working expenses to £13,893. From the gross profit of £14,657 the sum of £6,196 was paid for interest, and £7,028 to sinking fund, leaving a net profit, after payment of bank interest, of £1,634. The output of the generating station—2,895,181 units—represents an increase of 15 per cent. over last year. Having referred to the reduction effected in the working cost (from 1·2d. per unit in 1903 to 1·05d. in 1904), including management and distribution, Mr. Giles states that a reduction in the charges for supply has become necessary, and suggests a uniform rate of 4d. per unit for lighting; and for power, 1½d. per unit for the first 1,500 and 1d. per unit after. The abolition of all meter rents is also recommended.

**Bolton.**—The Corporation Electricity Committee has decided to reduce the price of energy from July as under: Lighting, 4d. per unit for the first three hours, and 1d. beyond; motive-power, 2d. per unit for the first 1,000 units per quarter, and 1d. beyond; with a discount of 10 per cent. on prompt payment. For energy for tramway purposes the charge is to be reduced from 1·25d. to 1·10d. per unit.

**Bulawayo.**—The Bulawayo Waterworks Co., which is also responsible for the electricity supply of the town, reports that the electric light revenue last year increased by 14 per cent. The number of consumers in February, 1903, was 482, and in February, 1904, was 536. On the joint undertaking the company has paid 2 per cent. on its ordinary shares for the year.

**Cardiff.**—At a meeting of the Lighting Committee held recently, Mr. Ellis, the electrical engineer, mentioned that he expected shortly to be in a position to state that Sir William Thomas Lewis had accepted the offer of the Corporation to supply electrical energy to the Cardiff Railway Co.'s premises at Bute Docks. The amount of power would be equal to 5,000 H.P. and the extra revenue to the Corporation would be between £25,000 and £30,000 per year. Mr. Ellis added that for the new Town Hall, law courts, and other buildings in Cathay Park, provision was to be made for 30,000 lamps.

**Devonport.**—The T.C. has reduced the price of energy from 5d. per unit to 4½d. for the first 1,000 units, and 4d. afterwards.

**Dunfermline.**—At a Dean of Guild Court recently the Fife Electric Power Co. applied for warrant to erect buildings in connection with the electric generating station at Townhill. Mr. P. M. Connell appeared for the petitioners, while Mr. W. G. D. Simpson, agent for the N.B. Railway Co., asked for a continuation. The latter stated that the Power Co.'s engineer reported that they were to build a retaining wall on railway property, which would interfere with the siding arrangements. Mr. Connell stated that they would keep the wall 18 in. outside of the Railway Co.'s fences, and after some discussion the plans were passed on condition that the Power Co. came to some arrangement with the Railway Co.

**Ebbw Vale.**—The U.D.C. has appointed a deputation to interview the Ebbw Vale Co. to ascertain whether it could undertake the supply of electricity for the district under the Council's prov. order, and upon what terms.

**Edinburgh.**—The T.C. has decided to reduce the charge for supply of energy for private lighting from 3¾d. to 3½d. per unit for the year as from the 16th inst.

**Germany.**—The municipal authorities of Neuss have decided to establish an E.L. works in the town at an estimated cost of £20,000.

**Gillingham (Kent).**—The T.C. has signed an agreement with the Admiralty for the supply of energy to the naval buildings for a term of three years.

**Gravesend.**—The T.C. has resolved to reduce the price of energy for power purposes to 1d. per unit, except during the evening load.

**Heavitree.**—The U.D.C. has appointed a committee to confer with Exeter T.C. relative to a supply of energy to the district.

**Hemel Hempstead.**—The Hemel Hempstead Motor Car Co. (Messrs. Pemsel & Wilson) has written to the T.C., stating that it has under consideration a scheme for the electric lighting of the district, and asks whether the Corporation would oppose the granting of an order. The T.C. has resolved not to assent to the proposal.

**Heysham Harbour.**—The electric power station at the new Midland railway harbour works contains the following plant, supplied by the British Westinghouse Co.:—Three 250-H.P. vertical gas engines, direct coupled to continuous current generators, working at 460 volts; storage battery of 230 cells; and a Mond gas installation. All cranes, capstans, passenger and luggage lifts, &c., will be operated by electricity.

**Italy.**—Application has been made by the municipal authorities of Taleggio for permission to put down a plant to utilise the water power of the river Salsana for the generation of electrical energy for lighting and power purposes.

**Kearsley.**—The U.D.C. is negotiating with the Farnworth Council for a supply of electricity.

**Kingston-on-Thames.**—The tenth annual report of the Corporation's electrical undertaking shows that the total capital expenditure up to March 31st, 1904, was £86,468. The amount of capital expended during the twelve months was £3,684, as against £2,711 capital repaid, leaving a balance of outstanding capital of £72,782. The revenue for the twelve months was £10,002, as against £8,341 in the previous year, and for the first time in the history of the undertaking, there is a net profit (£102) after paying interest, instalments of loans, and all charges. Of the additional income obtained during the year, £1,043 came from private consumers. It is intended to borrow £15,850 shortly for extension purposes.

**Lancaster.**—The Corporation has reduced the price of energy for motors from 3d. to 2½d. per unit.

**Llandilo.**—The U.D.C. has resolved to pay Mr. Bertram Thomas the sum of £330 for the maintenance of the electric light installation, from August 31st, 1903, to August 31st, 1904, and to take over the watt-hour-meters fixed by him at the station, paying him cost price for the same.

**Llandrindod Wells.**—The Electric Lighting Co. has consented to reduce the charge for the hire of meters, from 14s. per annum to 10s.

**London.**—HACKNEY.—In recommending that a bonus of £540 be paid to Messrs. J. and H. Holmes & Co. for low steam consumption of generating plant supplied, the E.L. Committee of the B.C. in a report issued on Tuesday said: "The consulting engineer states that the results are by far the best he has ever obtained from plant of similar size, and the contractors have thoroughly earned the bonus. The test figures are amply confirmed by the results of the actual working, and the record for last year of the lowest works cost of all metropolitan undertakings is in itself an excellent witness of the economy in working." The Committee also recommended that on and after January 1st, 1905, the scale of charges to consumers not on the books of the department at this date be:—For lighting, 7d. and 1d. per unit maximum demand; for power, 3d. and 1d. Queen's Road and Graham Road are to be lighted with ten 7-ampere lamps at an annual cost of £158 per annum; the expense of providing the lamps, cables, &c., is estimated at £705.

STEPNEY.—The E.L. Committee has resolved, upon the advice of the electrical engineers, to reduce, during the six summer months of each year, the number of hours at which the charge of 8d. is demanded from 30 to 20, and it is stated that this, on the estimated output, will effect a considerable saving on the rate for street lighting. A flat rate of 1d. per unit for power has also been adopted.

**Melton Mowbray.**—The pumps for supplying the water troughs on the Midland Railway are to be driven by three electric motors, energy being supplied by the Melton Mowbray E.L. Co.

**Middlesbrough.**—A L.G.B. inquiry was held on the 16th inst. into the application of the Corporation for power to borrow £20,000 for the extension of its electrical plant.

**Mussoorie (India).**—A scheme for the supply of electric power for Mussoorie and Landour has been drawn up by Mr. Billinghurst, late state engineer, Bikanir. Electricity is to be generated by the power obtained from the Kampti Falls, about 2½ miles distant, the minimum power available being sufficient for 434 effective H.P. The energy will be utilised to pump water to supply the town, from certain springs to the top of Blutcher's Hill. The scheme also provides for the lighting of 13½ miles of public roads, with a surplus for private lighting. The total cost of the scheme is estimated at 6 lakhs of rupees.—*Indian Engineering.*

**Nelson.**—On May 19th a L.G.B. inquiry was held into the application of the T.C. for a loan of £25,000 for E.L. purposes. Of this £13,715 was in respect of money already spent, and £11,285 for extensions now required, including one 400-KW. set, a Lancashire boiler, an additional panel to switchboard, new distributing mains and service connections, and a motor-generator. There was no opposition.

**Norwich.**—It is stated that the receipts of the E.L. undertaking for the first year under municipal control amount to nearly £27,000—an increase of 16¼ per cent. on the previous year. The increase in the number of units sold is 338,529, and the decrease in the cost of coal and oil £169, which is attributed to the system of bonuses to stokers. There was an increase of 5 per cent. in the working expenses, and a saving in salaries of £135. The gross profit amounts to £15,147; £8,030 has been appropriated to interest on loans, and £3,327 to sinking fund; and after meeting all charges, there is a balance in hand of £4,432.

**Penge.**—The Blackheath and District Electric Light Co., who wishes to introduce the electric light in Penge and the neighbourhood of the Crystal Palace, is experiencing some difficulty in coming to satisfactory terms with the T.C. Last year the company got a Bill passed by Parliament, the object of which was to acquire the undertakings of the Crystal Palace Electric Light Co. and the Lewisham and District Electric Light Co. When the Crystal Palace Co. undertook to supply energy for lighting purposes, it took in certain portions of the districts of Beckenham and Penge, and the arrangements with this company could only be put an end to at the expiration of 14 or 21 years. In 1899, Beckenham started its own electric lighting station, and claimed the right to purchase that portion of the Crystal Palace Co.'s undertaking within its district; that purchase has now been concluded. In 1900, the Penge U.D.C. commenced negotiations with the Lewisham District Electric Light Co. for a supply of energy for lighting

purposes for that portion of the district not within the Crystal Palace Co.'s area. An agreement was signed in 1901, by which Penge surrendered its rights to light the district by electricity to the Lewisham Co., the latter undertaking to supply energy at 4½d. per unit for private consumers, and 3d. per unit for street lamps but this was on the understanding that the light should be installed within two years from August, 1901. The Lewisham Co., however, never commenced operations, and eventually handed over its powers to the Blackheath Co. Previous to the Bill to acquire these undertakings being passed last year, the Blackheath Co. approached the Penge Council for permission to alter the terms of the agreement to 6d. per unit for private lighting, and 2½d. per unit for street lamps. This the Penge Council refused, and indications went to show that the Council was anxious to annul the agreement altogether. The period for the carrying out of the order expired in August last, and the Council is now considering the advisability of applying for the order to be discharged. The Blackheath and Greenwich Co. still has power to lay mains in the Anerley district (Crystal Palace Co.'s area), but unless that work is carried out shortly, that also will lapse. Very recently arrangements were made for the supply of energy from Beckenham for the Penge tramways, and it is therefore not unlikely that arrangements for lighting will be made in that district also.

**Plymouth.**—The T.C. has reduced the price of energy to private consumers from 4½d. per unit to 4d., and for motive power from 3d. to 2½d.

**Prestwich.**—The U.D.C. on May 18th sealed an agreement to transfer to Salford the E.L. Order obtained in 1900.

**Saffron Walden.**—The T.C. has applied to the L.G.B. for a loan of £10,150 for E.L. purposes.

**Stafford.**—At the meeting of the T.C. last week, Alderman C. H. Wright, chairman of the Gas and Electricity Committee, gave a *résumé* of the Committee's annual report, from which we learn that, in the Electricity Department, the total revenue was £2,879 7s. 10d., expenditure £1,332, leaving a gross profit of £1,547. Interest charges and loans repaid amount to £1,852, and in addition the Committee has decided to place £400 to a depreciation fund for the renewal of cables, and £212 to the same fund for the renewals to the battery.

**Stirling.**—The T.C. has resolved to approach the Secretary for Scotland for authority to borrow £4,300 for probable extensions in connection with the electric lighting of the town during the next three years.

**Stockton-on-Tees.**—The T.C. has appointed a committee to consider the advisability of providing plant for utilising the surplus steam from the refuse destructor for electricity generation.

**Sydney.**—The recommendation of the E.L. Committee, "That the tender of Messrs. Dick, Kerr & Co., in the sum of £23,811, for the supply of additional electric lighting machinery, with Willans engine and Allen condensing plant, be accepted, as recommended in the report of Messrs. Preece and Cardew, of January 22nd, 1904, and the resident electrical engineer, of March 25th," was considered last month by the City Council. Alderman Meagher moved an amendment to the effect that the tender of the British Westinghouse Co., at £23,651, be accepted. This was rejected, and the original recommendation was carried by 11 votes to 8.

**Tynemouth.**—A L.G.B. inquiry was held on the 18th inst. at North Shields into the application of the T.C. for powers to borrow £15,000 for E.L. purposes. Mr. C. Turnbull, the borough electrical engineer, explained the reasons for extending the plant, works, &c., and said that in the first year they sold 482,000 units, in the second year 820,000 units, and in the third year, which had just ended, 1,103,000 units. In addition to this they had connected up motors of 525 H.P., and applications were still coming in rapidly, so that they would have to extend their plant. As to the mains and services in the Cullercoats district, which was included in the present scheme, he mentioned that the district was a long way from the power station, and the Corporation took a bulk supply from a private company for that district.

## TRAMWAY AND RAILWAY NOTES.

**Birmingham.**—The Tramway Committee has submitted its report for the year ending March 31st, 1904, which includes the three months during which the first electrified line has been running. The capital account stands at £50,000, of which £34,171 has been spent. The revenue account shows receipts of £4,428, including traffic receipts of £3 657, and expenditure on power, traffic, general and maintenance charges of £2,764, leaving a balance of £1,664 absorbed as follows:—£685 on preliminary expenses, £296 interest on loans, and £682 surplus carried forward.

The report states the Council still awaits the company's claim for the routes to be purchased by the city within the city boundaries.

The Dudley Road route is now nearing completion. The cars commenced running on the Pebble Mill to Cotteridge route, on 20th inst., as far as the railway bridge at Cotteridge.

The Yardley end of the Small Heath route having been electrified by the City of Birmingham Tramways Co., the following proposed terms have been recommended for acceptance:—

1. The Corporation to re-lay the tramways, and the company to pay interest on the cost at the rate of 15 per cent. per annum until their lease expires at December 31st, 1906.
2. The company to construct the necessary works and apparatus for moving the cars by overhead electric traction.
3. Tramcars, approved by the Corporation, to be provided by the company.
4. The company to take all necessary precautions as to overhead telephone and telegraph wires.
5. The Corporation, at the expiration of the company's lease, to purchase all the overhead work and feeders at the then value of same.
6. The Corporation to have the right to use the poles for street lighting purposes.
7. The company to comply with any reasonable requirements of the Corporation as to the safety of passengers.
8. From and after January 1st, 1907, up to and until June 30th, 1911, the following provisions to have effect. The Corporation and the company to be entitled to run cars over the tramways belonging to the other so as to form one continuous route between the city terminus for the time being for this route and Yardley, and the Corporation and the company to provide current for their respective lengths of tramways.
9. Each contracting party to be entitled to the whole of the receipts on their own respective tramways.
10. The receipts from fares from cars which cross the boundary to be apportioned in proportion to the length of their respective tramways, one to the other.
11. The Corporation are not to extend the 1d. stage from the city terminus beyond the Small Heath Park, and no other fare than 1d. to be charged by either party between the terminus for the time being of the 1d. stage from the city terminus and the present terminus at Yardley.
12. The number of cars provided by each party to be mutually arranged, failing agreement by arbitration, and to be provided in proportion to the route mileage of their respective tramways. An additional clause provides that each party will be responsible for any accidents, &c., caused by their respective cars while on the tramways of the other party, and that all disputes will be settled by arbitration.

**Blackburn.**—In his fifth annual report upon the working of the Corporation tramways, Mr. A. S. Giles, the tramways manager, shows that the passenger receipts were £43,374, and other receipts £1,308, a total revenue of £44,682. Working expenses were £29,369, leaving a gross profit of £15,313. Of this sum £8,818 was applied to interest on loans, and sinking fund absorbed £11,633, leaving a deficit of £5,138. The interest and sinking fund charges, it is pointed out, include £5,627 on the capital charges representing the purchase price of the tramways from the old companies. The traffic receipts have not increased, the average passenger receipts per car-mile declining from 11·89d. to 10·89d., this drop of 1d. per car-mile representing £3,964 for the year. This falling off, Mr. Giles adds, is largely attributable to bad weather and trade depression, and the new extensions of line have contributed to the loss. The mileage has increased in the past four years from 637,266 miles to 951,484; passengers from 6,759,511 to 7,742,692; receipts from £31,329 to £43,198; and receipts per car-mile have decreased from 11·79d. to 10·89d. The expense of maintaining the lines and rolling-stock in efficient working order is borne by the revenue account. With regard to working expenses, which are 7·4d. as against 7·45d. last year, the largest item is for power. Eliminating this, the cost of 4·59d. will compare favourably with any tramway costs elsewhere, and while it is not possible to reduce traffic expenses much below the present figure, the cost of energy per car-mile might be reduced. On this important point, Mr. Giles says that, while the charge of 1·5d. per unit for electric energy may not be reducible at present, the amount of energy used per car-mile might be reduced. From meters fitted to several cars, showing the energy used by different drivers, he finds the consumption varies as much as 30 per cent. between the highest and lowest; and after due allowance (about 10 per cent.) for state of rail, wind and weather, the increased energy used by some drivers leads to the conclusion that they do not pay proper regard to the instructions on economy laid down. To meet this, Mr. Giles suggests the payment of a bonus to drivers who combine economy of energy with the efficient running of cars, the scale proposed being as follows:—If the weekly consumption is reduced from the average of 1·87 B.T.U. to 1·77 B.T.U. per mile, 1s. per week bonus; reduction to 1·67 per mile, 2s. per week; and reduction to 1·57 per mile, 3s. per week. Such reduction, after payment of the bonus, would effect a very considerable saving per annum.

**Bournemouth.**—At the Surveyors' Institute, Westminster, before Mr. William Eve and Mr. Robert Vigors, two rating valuers, with Mr. A. S. Lawrence, K.C., sitting as umpire, the arbitration proceedings between the Bournemouth Corporation and the Poole and District Electric Traction Co. are to be conducted.

The object of the arbitration is to determine the price to be paid under the agreement for purchase, representing the fair market value as a going concern (*a*) of the Poole tramway which has been working since 1901 and (*b*) of the powers and rights of the company to construct a tramway from the Bournemouth borough boundary at Pokesdown to Christchurch and Purewell, by the Corporation in the first instance. The question of the value of the running powers which the company possess may also have to be determined.

The Poole Corporation some time ago made an offer for the Poole undertaking, representing a sum of some £60,000, which the company respectfully declined. It was generally believed that in reply to that the company made an offer to sell for £220,000.

**Cambridge.**—The T.C. has passed a resolution approving of the proposal to electrify and extend the tramway system. The local electric tramways syndicate has communicated with the Council on the matter.

**Dewsbury.**—A serious accident happened on the Yorkshire (Woollen District) Electric Tramways, at Dewsbury, last Friday afternoon. A car coming from Heckmondwike was running down Halifax Road, which is narrow at points, and has a two-mile descent with a gradient of 1 in 10 over some portions. All went well until the car reached a point about three-quarters of a mile from Dewsbury. Here, says our local correspondent, the driver stopped to put down a passenger. Immediately in front of him was a steep decline, and on re-starting, he applied his brakes, but he declares that they failed to act, and the car rushed down the hill at an

alarming speed. A light mineral water cart was thrown aside and smashed, the contents being strewn about the road, and the horse stripped of all its gears. The car continued its course down the road at an increasing rate of speed, the driving calling out to a ticket inspector, who was standing in the road, "She's off! I can't stop her." Part of the driving apparatus had been knocked off by the collision with the mineral-water cart, and the driver lost his hold. About a quarter of a mile from the Market Place he was thrown off the car, alighting on his head. At this stage the car was estimated to be travelling at the rate of 40 miles an hour. It ran on, and near the centre of the town, knocked over a coal cart, the vehicle being smashed and the horse injured. The runaway car then dashed into the rear of a car from Birkenshaw, which was going into the Market Place. The force of the impact was so great that the conductor of the Birkenshaw car was sent flying through a plate-glass window, and the driver pitched into the road. This car was sent through the Market Place at a furious speed, but after travelling about a couple of hundred yards, it came to a standstill. The Heckmondwike car appears to have jumped the metals, but it still continued to run. It was not until it reached the centre of the Market Place that it came to a standstill. Here it collided with a car from Ravensthorpe. Either it or the Birkenshaw car overturned, and smashed a wagon laden with vitriol. The front portion of the runaway car was completely wrecked, the driving gear being torn away, the steps smashed, and the windows broken. Five persons were removed to the Dewsbury Infirmary. Oldroyd, the car conductor, displayed remarkable coolness. He stuck to his post to the last. Several of the passengers attempted to get out of the car, but he pushed them back, and held the door fast. After the accident, the passengers expressed their indebtedness to him.

**Edmonton.**—The U.D.C. resolved last week (in committee) to grant the North Metropolitan Tramway Co. consent to the laying of mains through the district for the purpose of obtaining electric energy for the traction of their cars, "under terms and conditions to be approved by this Council."

**Folkestone.**—Lord Radnor, as Lord of the Manor, has declined to consent to the use of the overhead system for the proposed tramways.

**King's Norton.**—The electric cars on the Pershore Road commenced running on the 20th inst. The total mileage is 5¼ miles, and the lease has been granted to the City of Birmingham Tramways Co. till 1911.

**Liverpool—Southport Railway.**—The *Liverpool Daily Post* says that the 10 minutes' electric service was resumed on 17th inst. between Liverpool and Southport.

**London.**—Mr. Graham Harris, the umpire in the recent arbitration arising out of the claim by the London, Deptford, and Greenwich Tramway Co. against the London County Council for the structural value of the tramway which runs from London Bridge to Greenwich, with branch lines, together with stabling, cars, and horses taken over by the Council under the new Tramways Acts, has published his award at £91,363. The hearing of the arbitration lasted several days, the expert valuations handed in on behalf of the claimants ranging between £105,000 and £106,000, while those for the County Council were slightly over £53,000.

**Paris Metropolitan Railway.**—This company reports that in consequence of the catastrophe of last August there was a loss of traffic amounting to £32,000. The *Financial Times* correspondent says that the total traffic receipts for the year, including revenue from advertisements, amounted to £704,700. The working expenses absorbed £303,100. The proportion of the traffic receipts taken by the City of Paris was £227,700. The total balance available for dividend and reserves was £174,200. The proportion of working expenses to receipts was 42 per cent. The amount paid as compensation for the catastrophe in August, 1903, was £46,000. The company is now working 34 kilometres of the 42 kilometres of line which will complete the first portion of the Paris Electric Metropolitan Railway. It has almost completed the construction of the Bercy power station, which will ultimately supply sufficient electric power for the whole of the line. The capacity of the Bercy station will be 14,400 KW., or, say, 20,000 H.P. A contract has been entered into for the supply of additional power should the traffic require it. In conformity with the requirements of the authorities, the company is renewing the whole of its rolling stock, and is adopting an improved system of traction, whereby short circuits will be made innocuous. The complete isolation of all electric machinery on the trains will be effected by the adoption of a system of multiple units, so as to render harmless the current circulating in the channels under the trains. The actual rolling stock of the company consists of 132 auto-motors, 109 first-class cars, and 221 second-class cars. The new rolling stock now being built will comprise:—167 bogie auto-motors, 28 bogie first-class cars, and 28 bogie second-class cars. The lighting arrangements in each station are now entirely distinct from the current used for traction, so that if an accident on the line should necessitate the switching off of the traction current, the lighting arrangements would not be affected. Extra exits have also been provided at many of the stations. A number of the company's servants, forming the council of a syndicate to which not more than 50 of the company's men belonged, were summarily dismissed for posting up a bill warning the public that it was dangerous to travel on the "Metro." in the existing state of the service. The medical service of the company costs £6,600 per annum, which some of the shareholders seemed to think was rather high. One of the shareholders suggested that phonographs should be placed in each car to announce to the passengers the name of each station. This is an illustration of the love of noise by the French, as the names of the stations might just as effectively be shown by means of an automatic board. Another shareholder complained that there was a continual draught in the trains, and opined that this was the direct cause of the chronic state of influenza which prevailed in Paris throughout the winter. The chairman stated that the company were endeavouring to obviate the nuisance complained of by introducing a new system of ventilation on the "lantern" system. Smoking is still prohibited on the premises of the Metropolitan Railway. The authorities and the company consider it would be highly dangerous to permit smoking cars. It is true that such cars have been in use for years in the London "Tube," but then Parisians always think they are wiser than other people. The dividend declared was 3 per cent., plus an extra dividend of 7 fr. 50 c. on each £10 share.

**Newcastle-on-Tyne.**—A meeting of the Parliamentary and Bye-Laws and Tramways Committees of the Corporation was held on the 17th inst. to further consider the application of the Tyneside and District Tramways and Tramroads Co. for running powers on the Corporation lines. It was somewhat expected that some representatives of the company would have waited on the Committee; they did not attend, but a letter was read from Messrs. Watson, Burton & Corder, solicitors to the company, in response to a counter suggestion of the Committee, stating that the modifications of the company's suggestions, as made by the Committee, made a consecutive service such as the company suggested impossible, whether the Corporation or the company were to conduct it. They feared that, having regard to the great divergence between the company and the Corporation, no useful purpose could be served by the directors again attending. They concluded with a regret that the efforts to come to an amicable arrangement had not been more successful. At the T.C. on the 18th a report was submitted from the joint committees, in which they confirmed their previous decision, and recommended the Council to agree to the company's proposals, as modified by the Committee, as follows:—

Wallsend traffic:—(1) Newcastle Corporation to turn no cars at Wallsend boundary, but to run all to Park Road, both on low and high line, either by a circular or shuttle service, retaining their own drivers and conductors; (2) Corporation may increase service to Wallsend at their option; (3) Corporation to pay to the company ½d. per passenger for every passenger carried in Wallsend, less operating costs of 2¾d. per mile. The ½d. per passenger to be reduced *pro rata* in respect of workmen and children; (4) fares charged by Corporation in Wallsend to be on the Corporation standard scale, with stages defined.

Willington Quay and Shields traffic:—(5) The Corporation to undertake to run the Newcastle service of cars in conjunction with that of the company, and meet the cars of the company at either Park Road, Wallsend, or any other point in Wallsend, or at the Walker and Wallsend boundary, as the company may prefer, in order that the passengers using the same may enjoy the greatest facilities; (7) the punctuality of the company's cars to be to the reasonable approval of the Corporation.

Gosforth Park Traffic:—(9) Newcastle Corporation to have entire control of Gosforth Park line during the races, and to retain the amount of the maximum fare on the Corporation line and half the amount of the fare on the company's line, for every passenger carried on that line, paying to the company the other half of the fare on their line. Fares between Central Station and Gosforth Park to be settled by agreement; (10) Newcastle Corporation to run sufficient special cars to Gosforth Park during races as will reasonably meet the requirements of the travelling public, regard being had to the requirements of the whole Corporation tramway system, and the number of cars for the time being owned by the Corporation; (11) The company to be allowed to run up to Gosforth Park with their own employés during races, but on their own part of the line only, the service to be under the control of the Corporation and not to injuriously interfere with the Corporation service; (12) Cost of making junctions to be borne equally by both parties; (14) Each party to supply all energy required by cars within own area; (15) The party operating the car to be responsible for accidents caused by or to same.

Tracks and overhead equipment of lines over which Corporation run, to be kept up to the satisfaction of Corporation. If agreement come to, Clauses 15 to 19, inclusive, in the Bill to be withdrawn.

It was agreed that the Council should meet on Thursday to consider the question.

**N.E. Railway.**—It is reported that the working of the electrical section of this railway has led to disturbances over the telegraph wires of the Post Office. As a result, reports a Newcastle paper, consultations have taken place between the experts of the G.P.O. and the railway company, and it has been decided to introduce a metallic circuit in connection with all the telegraph wires that lie parallel to the electrified route.

**Rhondda.**—The U.D.C. has made arrangements with the B.E.T. Co. for the purchase of the horse tramways at Perth for £7,250.

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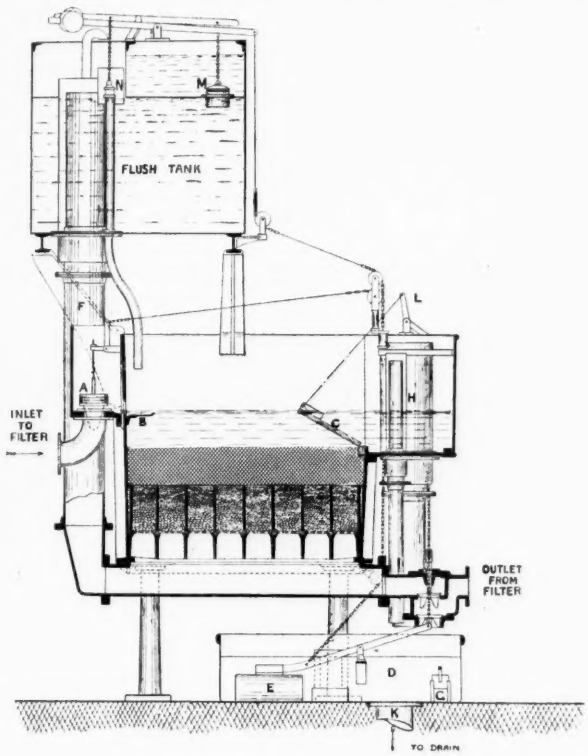
**The Héroult Steel Process.**—According to H. Becker, the Héroult electrical process for the manufacture of steel is being worked by the Elektrometallurgische Gesellschaft at La Praz. A mixture of equal parts of powdered graphite and iron filings moistened with tar is formed into briquettes, submitted to considerable pressure, carbonised, and finally treated in a specially designed electric furnace known as the converter. The steel produced in this way contains 0·007 per cent. of sulphur, 0·003 per cent. of phosphorus, 0·15 per cent. of manganese, 0·003 per cent. of silicon, and from 0·60 to 1·80 per cent. of carbon. About 6 to 7 tons of steel made by the Héroult process are being turned out at La Praz every day, while the same process is at work in Sweden. It is also stated that experiments have been tried successfully at La Praz on the use of sodium for the refining of the steel.

# LEICESTER CORPORATION ELECTRIC TRAMWAYS.

(*Concluded from page* 836.)

The feed is taken from the hot well, the separation of the oil from the condensed steam being effected by the Davis-Perrett patent electrical process. In this process




Section of Wilson Automatic Filter.

the water passes through a series of tanks in parallel, and is subjected to the action of an electrical current, the result of which is to immediately destroy the emulsion and form a flocculent precipitate, which can then be easily removed by subsequent filtration, leaving the water absolutely pure. The electrical portion of this plant was supplied by Messrs. Davis-Perret, Ltd., of 13, Fenchurch Avenue, E.C., and the filters used are the Wilson patent automatic self-cleansing filters, made and supplied by Messrs. Masson, Scott & Co., Ltd., of Fulham, S.W., who have erected the entire plant.

The water, as it issues from the 10 divisions of the electrical tanks, is received in two collecting tanks, whence it passes into the patent filter continuously, and is delivered into a storage tank; from this the boiler feed pumps draw their supply.

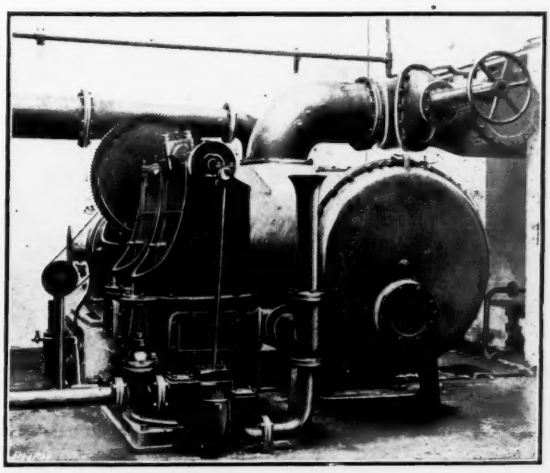
The sectional drawing of the filter will indicate its construction. The bottom of the filter is cellular, each cell being divided vertically into two parts. The division plates are perforated to allow of the water passing through. The upper part of the cells contains large stones, then smaller stones, upon which the sand rests. The lower part of the cells forms an air space and trap.

The water enters the filter at the point A, B, through holes in the side plates of the filter, passes through the sand medium and stones, and leaves the filter by the outlet valve. The latter is shown closed, but during the filtering operations this valve is of course open.

As the surface of the filter becomes coated with impurities, the level of the water gradually rises, because it enters the filter more rapidly than it passes through the sand, owing to the obstructions. When it reaches the top it overflows a siphon pipe H shown on the drawing, and descends rapidly into the float chamber, D, underneath. In this there is a float fixed on a lever. The water raises this float, and by so doing closes the outlet valve by which the unfiltered water escapes from the filter, and at the same time allows the water from the flush cistern above to flow down very rapidly into the underside of the filter.

The water descending with considerable force presses upon the air in the underside of the cells, forcing the air up through the sand, which is thus broken up, and is thoroughly washed by the water as it rises up through the medium. The sand would escape from the filter except for a board C extending right across the filter, which, being fitted with a float, rises up as the water rises in the filter, and prevents the sand from passing out. When the flush water is exhausted, the operation of washing is complete. The water escapes from the float chamber D, and the float E falls again to the bottom of the chamber. The outlet valve is again opened, and the ordinary operation of filtering is proceeded with. The whole operation only takes about three minutes, and while this is going on the collecting tanks are sufficiently large to receive the water passing from the electrical tanks, so that the continual flow of the water is not interfered with.

The condensing plant consists of a surface condenser capable of dealing with 25,000 lbs. of exhaust steam per hour, and, with the exhaust steam pipes and accessories, was made for Messrs. Dick, Kerr & Co. by the Mirrlees, Watson Co., Ltd., of Glasgow. The exhaust steam from the several engines is led into a common exhaust main running along one side of the engine house, and then to the condenser house, which is situated at one end of the main building;



Mirrlees-Watson Condensing Plant.

there is a branch from this pipe leading to a vertical atmospheric pipe, fixed to the outside wall of the building, and terminating in an improved form of exhaust head and silencer. An automatic atmospheric relief valve is provided. The exhaust steam, before reaching the condenser, passes

through an oil separator, manufactured by the Klein Co. The condenser, which has 2,500 sq. ft. of cooling surface, is designed on the Mirrlees, Watson counter-current system, the exhaust steam and cooling water each passing twice through the full length of the condenser in opposite direc-

Overhead Construction at the Clock Tower Junction.

tions. The air-pumps are of the Edwards patent type, and with a centrifugal circulating pump, are driven by a double-wound series-parallel motor manufactured by Messrs. Dick, Kerr & Co., Ltd. The air-pumps have barrels 18 in. diameter × 10 in. stroke, and run at a maximum speed of 100 r.p.m. The centrifugal pump is capable of delivering 1,500 gal. per minute, and is regulated by means of a series-parallel controller. The centrifugal pump is direct connected to the motor by a flanged coupling, and the air-pumps are driven by single reduction gearing having machine-cut teeth. A small plunger pump is carried on the air-pump bed-plate and driven from a crank disk mounted on the end of the crank-shaft. There is another small pump driven by chain gearing, which draws the oil and water from the oil separator and discharges them into the waste oil tank. The air-pump crankshaft is carried on an improved form of frame, which has been designed to give much greater stability than the usual form of A-shaped frames.

The storage battery is composed of 240 Tudor cells of type No. 413 H.F. 19; it is capable of giving 600 amperes for one hour or 900 amperes for short periods, and can be charged normally at 270 amperes, or at 450 amperes for short periods. The plates are contained in lead-lined wood boxes resting on glass oil insulators; the stands are entirely of pitch pine without any metal fastenings, and rest on large porcelain oil insulators to ensure perfect insulation.

This battery is used in connection with a reversible booster controlled by means of a Thury patent regulator.

The Thury booster differs considerably from those of other makes, the armature being of the smooth core type and the field coils tangential. The booster dynamo has two commutators, which can be connected up in parallel or series to meet all requirements as regards the automatic regulation of the load on the plant and the charging of the battery.

The main switchboard was supplied by Messrs. Dick, Kerr and Co., and consists of 25 panels of white marble, controlling, besides the three 500-kw. generators, a negative feeder booster set of 20-kw., a positive feeder booster set of 60-kw., an automatic reversible battery booster set of 40-kw., the station lighting and motors, and the distribution system.

There are three generator panels, each carrying:—ammeter, circuit-breaker, two main switches, watt-hour meter, shunt regulating switch and resistance, field switch with resistance, and a 4-way voltmeter plug socket.

One meter panel, carrying recording ammeter, watt-hour meter to register the total energy generated, and short-circuiting plugs for these instruments.

One reversible booster motor panel: One reversible booster panel fitted with circuit breaker, battery voltmeter, booster volt and ammeter, double-pole 3-way switch, single-pole switch and fuse, two watt-hour meters, and recording ammeter: One standard Board of Trade panel: One station lighting and motor panel: Two motor panels; Two negative booster panels, one being spare: One 80-kw. motor panel: One positive booster panel, and eleven standard traction feeder panels, each carrying ammeter, circuit breaker, single-pole switch, kicking coil and lightning arrester.

The motor starters throughout are of Messrs. Dick, Kerr and Co.'s slow speed type, with automatic over-load and no-load release and metallic shield blow-out device. The circuit breakers are also of their new standard type, with metallic shield blow-out. The ammeters and voltmeters throughout are of the sector illuminated dial type. Fireproof cables have been used throughout the power station for connecting up the machines.

The whole of the cables have been supplied and drawn in by Messrs. W. T. Glover & Co., Ltd., of Manchester. The stoneware conduits for the feeders and pilots are of the patent self-centring type, with composition joints, and were supplied by Messrs. T. Wragg & Sons, Ltd., of Swadlincote, the total quantity of conduits supplied being equivalent to about 80,000 yards of single way.

The drawing-in chambers are built of bricks in cement. The work of laying the conduits and the construction of the chambers were carried out by the Corporation workmen. The drawing-in chambers are provided about 80 yards apart; they have ventilating covers, and have been designed with a view to securing ample room for inspection and working, and also to provide for future extensions. Throughout the entire system the conduits are laid at the side of the track. The cables are single conductors, insulated with diatrine impregnated paper and lead-covered, with lead sleeve wiped joints. At intervals of approximately $\frac{1}{4}$ mile the lead

Laying the Cable Conduits.

covering of the cables is earthed to the rails by means of bare copper bonds, as a preventative against electrolysis.

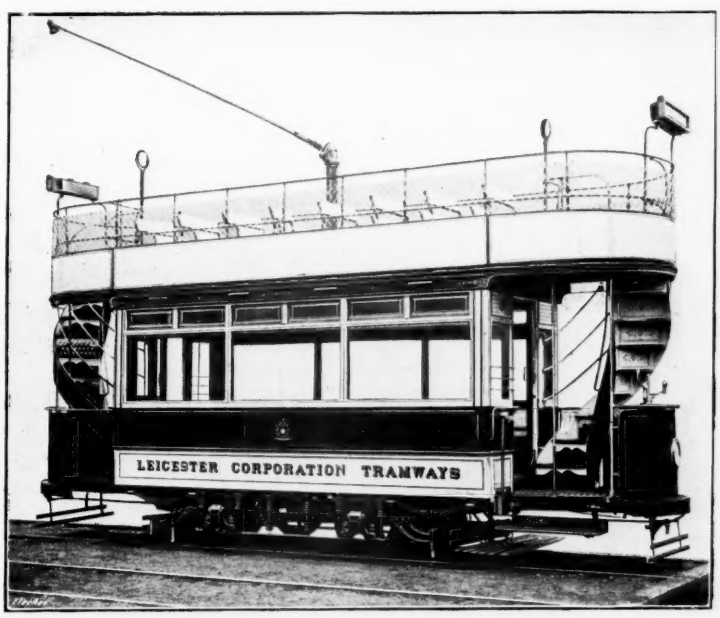
Three negative feeders have been carried out to different points of the system, and are connected to the rails through special feeder-boxes, having the necessary Board of Trade instruments mounted therein. Each cable bears a brass

Centre Pole Construction.

label in every box, denoting its size, voltage and termination. The sizes of the feeders range from ·1 sq. in. to ·5 sq. in., the total length being over 20 miles.

A complete system of telephone and pilot cables is also drawn into separate ducts along each feeder route, and connected up in every feeder and section box.

All lead-covered cables terminate in the basement of the power station. Connection is made to the switchboard with fire-resisting cable of Messrs. Glover's latest type, the whole of the cable work in the station being of this description.




Dick, Kerr Double-Deck Car.

The whole of the feeders and pilots were submitted to a pressure test of 1,000 volts alternating for one hour, which proved in every way satisfactory.

The design of the centre, span, and side bracket pole ornamentation, was prepared by Mr. Mawbey in conjunction with the Leicester Art School. Span wire construction has been adopted generally, but where the roads are wide enough centre poles have been introduced. In the centre of the town where suitable attachments could be obtained, poles gave place to rosettes, except at junctions, these being erected on poles throughout. Each centre pole has been fitted with two incandescent gas lamps, and the base is protected by a neat guard kerb, this work being carried out by the Corporation staff. Side bracket arms have been used on one short length.

The poles are of two grades, A and B, the former being used on the straight, and the latter on the curves, at junctions and for anchorage. The respective weights of the poles are 840 lbs. and 1,180 lbs. The total length is 31 ft., made up of three sections shrunk together.

The trolley wire is No. 000 B. & S. gauge throughout, except at the car depôts, which are wired with No. 0; and the span and guard wires are of galvanised steel, 7/12 and 7/16 respectively. Flexible bow-string suspensions and double insulation have been adopted throughout. The trolley wire is with few exceptions suspended over the centre of the track, a deviation of 3 ft. only being allowed. "Aetna" insulation, and line fittings of extra strong design, have been used throughout.

Telephone and other wires crossing the routes have been removed wherever practicable, so that very little guard wire has been erected. Special arrangements were made whereby the Telephone Co. have placed the whole, and the Post Office the bulk, of their wires underground.

Four sizes of section and feeder pillars are used, fitted with white marble panels, which carry the various quick-break switches, kicking coils, and fuses.

Each pillar is also fitted with a Garton lightning arrester, and an ebonite panel carrying the test and telephone terminals. All holes in the panels are fitted with ebonite bushes and washers.

A specially-designed telephone shutter operated by a separate key has been fitted to each pillar, arranged on the General Electric Co.'s system, so that it is unnecessary to open the pillar in order to use the telephone, the jack being inserted from the outside, thus obviating the danger of anyone accidentally coming in contact with the "live" fittings in the pillar when using the telephone.

The telephone instruments are carried on the cars, one being supplied to each car.

Two negative feeder pillars are erected to meet the present requirements, one at the Clock Tower and the other at Highfield Street, approximately 1,100 and 2,700 yards respectively from the power station. They contain the usual instruments to meet the Board of Trade requirements.

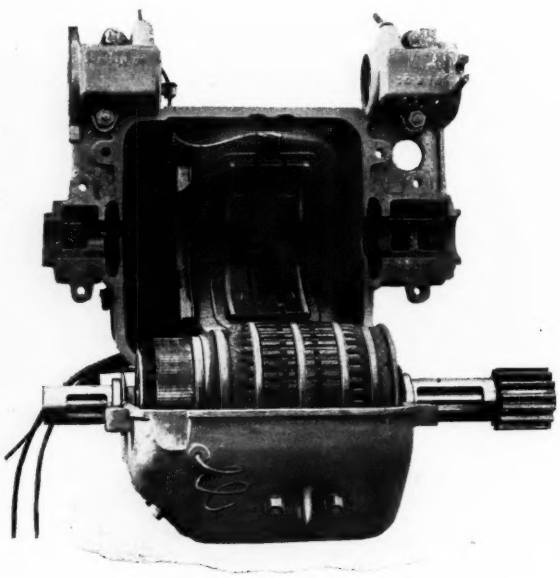
All section and feeder pillars, and the poles up which the feeder cables have been carried, are bonded direct to the rails by a No. 0000 copper bond, to prevent

Entrance to Main Car Depôt.

the possibility of their becoming "alive" owing to breakdown of the insulation at these points.

The whole of the equipment was supplied and erected Messrs. R. W. Blackwell & Co., Ltd., London.

The cars are of the double-deck single-truck type with



Dick, Kerr Car Motor, Open.

reversed stairways, and were supplied to the number of 59 by Messrs. Dick, Kerr & Co., Ltd.

The seating capacity of the cars is 22 inside and 34 outside, and overall dimensions 27 ft. 6 in. over fenders by 6 ft. 10 in. width over sills.

The cars are mounted on 21E Brill trucks, each of which carries two 25A Dick, Kerr motors, rated at 25 H.P. The controllers are of Dick, Kerr & Co.'s new type, fitted with the "Magnetic Shield" blow-out, which causes the arc to be broken practically instantaneously, and in such a manner as to reduce the burning and deterioration of the contacts to the smallest extent possible. The controllers can also be used for converting the motors into an electric brake should occasion arise. The braking effect can be graduated.

The Hudson & Bowring life-guard has been fitted under both platforms. As the gradients in Leicester are comparatively slight, the adoption of special brakes has not been found necessary.

On several of the cars, a new patent step, to be known as the "Leicester folding step," has been fitted for practical trial to meet the suggestions of the Board of Trade, who point out that the efficiency of the lifeguard is often impaired by the steps, which are liable to strike a person falling in front of the car, before the life-guard can come into action. This step is designed to fold up when the gate is closed, and is so arranged that it is practically impossible for it to be raised when the gate is open, whilst owing to the automatic device with which it is provided, it is equally impossible to keep the gate closed without having the step raised.

Special means have been adopted to efficiently ventilate the interior of the cars.

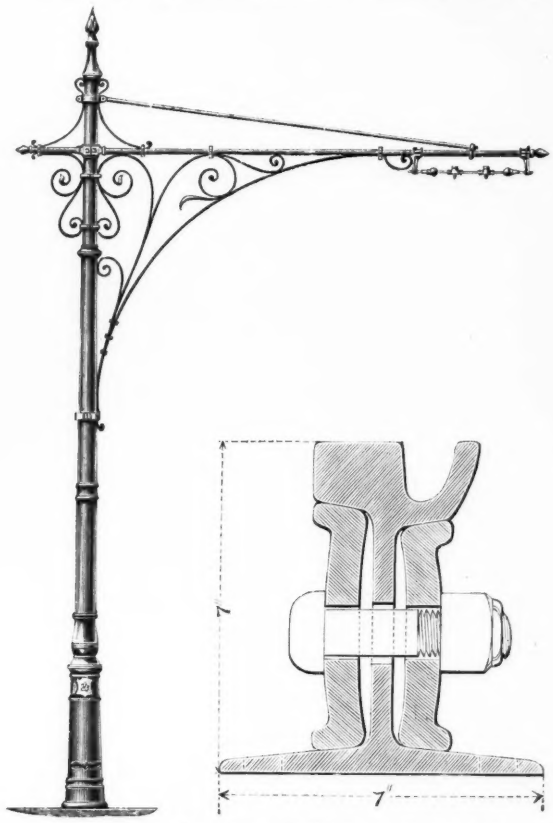
The English Electric Co.'s route indicators on the illuminated blind principle are fitted.

The main car depôt, in Abbey Park Road, stands on a site of about 4¼ acres, acquired from the Estates Committee, and is in close proximity to the generating station.

In designing this depôt, special attention has been paid to the arrangement of the tracks laid into the shed, with a view to getting the cars out in the morning as quickly as possible.

The car-shed proper consists of three bays, each of 35 ft. span, and containing three tracks, accommodating altogether 55 cars. The rails are supported throughout on piers, thus forming pits under the whole area, excepting for a short space at each end. The entrances to the car-shed proper and to the shops are fitted with Kinnear rolling blinds.

The fitting shop averages 130 ft. × 41 ft., and contains two tracks, which accommodate eight cars. On one side of these shops space has been reserved for installing a

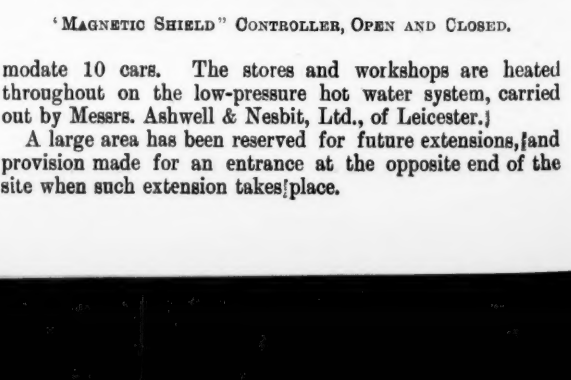



Elevation of Side Bracket Pole, and Section of Rail at Joint.

complete equipment of electrically-driven machine tools, the greater portion of which is to be laid down immediately, including 12-in. and 6-in. lathes, wheel-turning lathe, radial drill, &c.

Provision has been made for an electrically-driven overhead crane.

The carpenters' shop and painters' shop together will accom-



"Magnetic Shield" Controller, Open and Closed.

modate 10 cars. The stores and workshops are heated throughout on the low-pressure hot water system, carried out by Messrs. Ashwell & Nesbit, Ltd., of Leicester.

A large area has been reserved for future extensions, and provision made for an entrance at the opposite end of the site when such extension takes place.

The contractors for the buildings were Messrs. Hutchinson and Son, of Leicester, the steel roofs and lattice girders being let in a separate contract to Messrs. Cross & Cross, of Walsall. The special track work was constructed by Messrs. Hadfield's Steel Foundry Co., Ltd., of Sheffield.

Two small district car-sheds have been erected on the same lines as the main car depôt, one in Narborough Road and one in London Road; each of these contains two tracks with pits under, and will accommodate six cars; an office and small messroom is attached to each.

Mr. John Scholes acted as clerk of works for both the generating station and the main car depôt; and Mr. A. Hardy for the two district car-sheds.

The chairman (Mr. Councillor S. Flint) and the vice-chairman (Mr. Alderman Thomas Smith) of the Tramways Committee have devoted themselves with untiring energy and ability to the tramways scheme and the undertaking generally; and very valuable services have been rendered to the Committee in various ways, particularly in connection with street improvement and paving works, by Mr. Alderman J. S. Vorley, the chairman of the Highway and Sewerage Committee. The borough engineer, Mr. E. George Mawbey, is especially to be congratulated upon the successful inauguration of the scheme, for which he is mainly responsible, and into which he threw himself heart and soul. We trust that the enterprise, so happily begun, may have before it a prosperous career.

## TELEGRAPH AND TELEPHONE NOTES.

**The Commonwealth and the Pacific Cable.**—We extract the following paragraph from the speech of the Governor-General (Lord Northcote) to the Senate and House of Representatives of the Commonwealth of Australia on March 2nd last:—

"A conference of representatives of the Governments interested in the Pacific cable will shortly be held in London for the purpose of considering its financial management, and the provisional agreement entered into between the Government of the Commonwealth and the Eastern Extension Telegraph Co."

In the course of the discussion on the address in reply, Mr. Conroy, of the House of Representatives, made the following remarks on the above-mentioned subject:—

"Turning again to the Governor-General's speech I find it is stated:—'A conference of representatives of the Governments interested in the Pacific cable will shortly be held in London for the purpose of considering its financial management, and the provisional agreement entered into between the Government of the Commonwealth and the Eastern Telegraph Co.' I believe that the Ministry will at least do me the justice of admitting that when they entered into the agreement with the Eastern Extension Telegraph Co., and set aside the opinions of the New Zealand and Canadian Governments, I declared in this House that they had been guilty of a gross outrage, that their action was distinctly against equity, that we were bound to consult the other parties to the agreement, and that to do anything else was to befoul the fair name of the Commonwealth. I am glad to see that even at this late hour the Government have repented of their action, and are seeking now to repair the mischief which they then did. I do not say that we should not endeavour to make the best possible arrangements for an effective service; but when we cannot be forced to do something that we are asked to do, we ought to be most anxious to appear before the world as a people ready to observe, not only the letter, but the spirit of the law. No such anxiety was displayed by the Government in the case of the agreement entered into with the Eastern Extension Co., and it is humiliating to think that the House did not condemn them for their action. Some of us did so, but although our protest was of no avail, I am pleased to think that the Government now recognise the force of our objections."

**Telephones in North Wales.**—A largely attended deputation, including representatives from Chester, Denbigh, Ruthin, Flint, Holywell, Colwyn Bay, and other districts in North Wales, had a private interview last week at the House of Commons, with Lord Stanley, Postmaster-General, in order to lay before him the grievances of local telephone subscribers, and to point out how inconveniently the districts were grouped. From a daily newspaper we gather that the Postmaster-General replied that he had already reconsidered the case of the Holywell district, and had at some sacrifice determined to place the Holywell subscribers in free communication with Flint, Connah's Quay, Buckley, and Chester. He pointed out that it was always to the interest of the Post Office to make the telephone system as great a convenience as possible, but regard must always be had to the capital expenditure involved in instituting the system. He promised to bear in mind the suggested alteration of grouping with a view to affording further facilities, and expressed his willingness to receive and consider any suggestion on the point.

**Telegraphic Interruptions and Repairs:—**

| Cables. | Interrupted. | Repaired. |
|---|---|---|
| Dominica-Martinique | May 5, 1904 | |
| St. Lucia-Martinique | May 7, 1904 | |
| Trinidad-Demerara No. 1 | Aug. 27, 1901 | |
| Cayenne-Pinheiro | Aug. 18, 1903 | |
| Anjer-Kallanda | Aug. 2, 1903 | |
| Reisea-Issa (Yemen)-Camaran | Oct. 23, 1903 | |
| Tarifa-Tangier | Jan. 18, 1904 | |
| Closed: Nagasaki-Vladivostock | Feb. 15, 1904 | |
| Closed: Port Arthur-Chefu | Feb. 18, 1904 | |
| Foochow-Formosa | Feb. 11, 1904 | |
| Dakar-Conakry | May 13, 1904 | May 21 |
| Gibraltar-Tangier | May 17, 1904 | |
| **Landlines.** | | |
| Seoul-Masampo | Feb. 13, 1904 | |
| Seoul-Gensan | Feb. 13, 1904 | |
| Anju-Ping-Yang | Feb. 25, 1904 | |
| Ninguta-Vladivostock | March 2, 1904 | |
| Moulmein-Bangkok | May 29, 1904 | May 31 |

## CONTRACTS OPEN AND CLOSED.

### OPEN.

**Batley.**—June 2nd. Superheater, piping, valves, &c. See "Official Notices" May 20th.

**Canterbury.**—June 1st. Boiler, piping, 300-KW. steam dynamo, switchboard and economiser. See "Official Notices" April 29th.

**Cheshire.**—Electric light plant, wiring and fittings, for Parkside Asylum new infirmary annexe. See "Official Notices" to-day.

**Chili.**—June 28th. Electric lighting of the city of Punta Arenas (Straits of Magellan). See this column for February 19th.

**Deptford.**—June 21st. Two 25-KW. steam dynamos, booster and switchboard, for the electric lighting of the new Town Hall. See "Official Notices" to-day.

**Edinburgh.**—June 4th. Copper strip for electric conductors. See "Official Notices" to-day.

**Exeter.**—June 9th. Permanent way, overhead equipment, cables and cars. See "Official Notices" May 13th.

**Handsworth.**—June 8th. Erection of generating station. See "Official Notices" May 20th.

**Holland.**—May 31st. Tenders are being invited until May 31st by the Municipal Authorities of Utrecht for the supply and laying of the armoured mains in connection with the municipal central electric lighting station.

**Italy.**—The Municipal Authorities of Carrara have just invited tenders for the establishment of a central electric lighting station in the town.

**Johannesburg.**—July 4th. Cables, conductors, and accessories. See "Official Notices" May 13th.

**Pontypridd.**—June 4th. Motors. See "Official Notices" May 13th.

**Portsmouth.**—June 11th. Pump and piping. See "Official Notices" to-day.

**Rochester.**—June 3rd. Permanent way and overhead line. See "Official Notices" May 13th.

**Rotherham.**—May 31st. Cable and meters. See "Official Notices" May 13th.

**Shanghai.**—July 30th. The Municipal Council invites tenders for a 24-mile electric trolley line concession. Particulars from J. Pook & Co., 63, Leadenhall Street, E.C., the London agents of the Council. See "Official Notices" May 13th.

**Spain.**—June 8th. The Spanish Post and Telegraph Authorities in Madrid are inviting tenders until June 8th, for the construction of an interurban telephone line between Madrid, Ciudad Real, Cordova, Seville, Cadiz and Malaga. Tenders are to be sent to La Direccion Général de Correos y Telegrafos, Carretas, 10, Madrid.

**Spain.**—July 15th. The Spanish Ministry of Public Works in Madrid is inviting tenders until July 15th for the concession for the construction and working of an electric tramway between Sarria to the foot of Vallvidrera mountain (province of Barcelona). Tenders are to be sent to El Ministerio de Obras Publicas, Madrid, whence particulars may be obtained.

**Stepney.**—June 20th. Electric light installation at the Public Baths. See "Official Notices" to-day.

**Warrington.** — May 30th. Mechanical stokers and water softener. See "Official Notices" May 13th.

CLOSED.

**Bridgewater.**—The Hart Accumulator Co. have received an order for a storage battery of 260 of their standard lighting type cells, required for the electric lighting of Bridgewater.

**Dublin.**—The Lighting Committee of the Corporation at a special meeting held on 13th inst. accepted the following tender for the extensions plant:—The General Electric Co., Ltd., £19,227 (with deferred payment for two years), for one 1,500-KW. three-phase extra high-pressure plant, consisting of Belliss engine and condensing plant, combined with General Electric Co.'s alternators; steam and exhaust piping, and extension to switchboard.

**Gainsborough.**—The U.D.C. has accepted the tender of the Postal Authorities for the provision of an electric fire alarm system at £46 5s. per annum for 10 years.

**Glasgow.**—The Electricity Department of the Corporation has accepted the offer of the Northern Wood Haskinizing Co., Ltd., for a supply of their wooden troughing for a certain portion of the high-tension mains to be laid from the Port-Dundas station to the Waterloo Street sub-station.

For additional low-tension switchboards and instruments for the Pollokshaws Road station and sub-stations, the following offers have been accepted:—Messrs. Witting, Eborall & Co., Ltd. (with Dorman and Smith's reverse current circuit breakers), for the sum of £604; the British Westinghouse Electric and Manufacturing Co., Ltd. (with feeder fuses), for the sum of £752.

The contract for cast-iron boxes required for the year ended May 31st, 1905, has been placed with the Falkirk Iron Co., at £600.

**Govan.**—The following is a list of the successful tenderers for the stores contracts, 1904-5, for the Burgh Electricity Department:—

| | |
|---|---|
| (1) Oil | Not fixed. |
| Engine packing and gauge glasses. | Dempster, Moore & Co. |
| Klingerit jointing and graphite | Ferguson & Timpson. |
| (2) Lead-covered and armoured cables and rubber-covered cables | |
| Mica sheets, binding and fuse wire | British Insulated & Helsby Cables. |
| Leadless cables | Callender's Cable Co. |
| (3) Rubber solution, strip and prepared tape and solder | General Electric Co. |
| (4) Bitumen for solid system | Callender's Cable Co. |
| Bituminous compound | Craig, Sharp, Ltd. |
| (5) Meters, all sizes | Chamberlain & Hookham. |
| (6) House fuse boxes | Keighley Electrical Engineering Co. |
| (7) Iron castings | T. & A. Paul. |
| (8) ,, pipes | M'Dowall, Steven & Co. |
| (9) Wrought-iron tubes | Wilson's and Union Tube Co. |
| (10) Bricks | Kelvinside Brick Co. |
| Cement | Scott & Rae. |
| (11) Ironmongery | Dempster, Moore & Co. |
| Brushes | Wm. Morier & Co. |
| (12) Paints | James Storer & Co. |
| (13) Timber | Robinson, Dunn & Co. |
| (14) Carbons | General Electric Co. |
| (15) Coal | Not yet fixed. |
| (16) Joint boxes | Cruikshank & Co. |
| (17) Motors, 1 to 3-H.P. | British Thomson-Houston Co. |
| ,, 4, 5, 7, 15 and 30-H.P. | Lancashire Dynamo Co. |
| ,, 10, 20 and 25-H.P. | Mavor & Coulson. |
| (18) Motor starters up to 5-H.P. | British Thomson-Houston Co. |
| ,, ,, above 5-H.P. | Sturtevant Engineering Co. |
| Switches of 30 and 50 amps. | Veritys, Ltd. |
| ,, ,, 75, 100 and 200 amps. | Bray, Markham & Reiss. |

**Hackney.**—The Electrical Committee has accepted the tender of Messrs. W. Cory & Son, Ltd., for Broomhill small coal for one year at 10s. per ton delivered alongside the works by barge. An order has been placed with Messrs. Reavell & Co. for a portable motor-driven air-compressor to cost £65.

**Heckmondwike.**—The U.D.C. has accepted the tenders of the following firms in connection with the extension of the electricity works:—

Pipework, Messrs. Thornton & Crebbin.
Engine and generator, Messrs. Dick, Kerr & Co. (without bedplate).
Boiler and stoker, Stirling Boiler Co., Ltd.
Switchboard, Mr. J. E. Statter.
Induced draught, the Sturtevant Engineering Co.
Cables, W. T. Henley's Telegraph Works Co., Ltd.

The total amount of the tenders is about £4,586.

**Howden Engine Contracts.**—Messrs. James Howden and Co. have recently booked the following orders:—

Hanley Corporation.—One 650-650-KW. engine (per the British Westinghouse Co.).
Lincoln Corporation.—One 220-KW. engine (per Messrs. Bruce Peebles & Co., Ltd.).
A. M. Peebles & Son, Ltd.—One 290-B.H.P. engine.
Lanark County Council (Cambuslang).—Two 80-B.H.P. engines (per Messrs. Johnston, Park & Co.).
Glasgow Corporation (Crawford Street Destructor Works).—One 40-B.H.P. engine (per Messrs. Wm. Harvie & Co.).

**Shildon.**—The Electric Lighting Co. has accepted the tender of Messrs. Heenan & Froud, of Manchester, for the erection of a refuse destructor.

**Stafford.**—The T.C. has accepted the tender of Callender's Cable and Construction Co., Ltd., for the supply of E.L. cables.

**Stepney.**—The B.C. has received the following tenders for the installation of the electric light at the Limehouse Town Hall:—

| | |
|---|---|
| F. E. Emerson & Sons, 60, Burdett Road, E. (accepted) | £200 0 |
| Barlow Bros. | 227 0 |
| Tamplin & Mackovski | 234 0 |
| J. C. Christi | 238 0 |
| Ward Bros. | 255 18 |
| J. Defries & Co. | 880 0 |

For the installation of the electric light at St. George-in-the-East Library:—

| | |
|---|---|
| Ward Bros. 28A, Basinghall Street, E.C. (accepted) | £92 4 6 |
| Tamplin & Mackovski | 117 0 0 |
| Barlow Bros. & Co. | 118 0 0 |
| J. C. Christie | 143 0 0 |
| F. E. Emerson & Sons | 144 0 0 |
| J. Defries & Sons, Ltd. | 215 0 0 |

## FORTHCOMING EVENTS.

Thursday, June 2nd.—At 8.30 p.m. Röntgen Society. Dr. C. A. Wright on "Experiments to Determine the Effects of Form and Winding upon Resonance Phenomena."

Friday, June 3rd.—At 9 p.m. Royal Institution. Prof. Svante Arrhenius on "The Development of the Theory of Electrolytic Dissociation."

Thursday, June 9th.—At 5 p.m. Institution of Electrical Engineers. Annual general meeting at 92, Victoria St., S.W.

## NOTES.

**Indian Notes.**—*Indian Engineering* says that an expenditure amounting to Rs. 14,600 has been sanctioned for a new electric erecting shop, and additions and alterations to the signal shop of the N.W.R. at Lahore.

Sanction has been accorded for providing telephonic communication along the E.I.R. line between Howrah and Burdwan, arrangements having been made for the supply of some 124 telegraph and 192 telephonic instruments.

**South African Notes.**—From our Durban correspondent:—

*Cape Town.*—The new electric lighting station of the Cape Town Corporation was opened on April 14th by the Mayor (Mr. W. Thorne, M.L.A.). The electrical engineer (Mr. W. F. Long, A.M.I.E.E.), in making his statement regarding the success of the department, mentioned that the number of 8-C.P. lamps for private use had increased from 2,100 in June, 1895, when the undertaking was started, to 78,850 in February, 1904, and with regard to power consumers, 200 B.H.P. in motors were connected in June, 1900, whilst in February of the present year, the total had increased to 1,375. At the commencement of the supply, energy was charged for at the "flat rate" of 1s. 2d. per unit, which was, however, abolished in 1897, and the present "sliding rate" was adopted, the price per unit ranging from 1s. 2d. to 8d.; in 1900 a further reduction was made for "day load" by which the price varied from 8d. to 4d. The Mayor in his remarks gave a brief sketch of the undertaking, said that the new installation had increased the capital expenditure to £260,337, and last year they were enabled to pay off all interest and sinking fund charges amounting to £9,244, to provide for depreciation £5,921, extensions £5,362, and £3,404 was carried over to the relief of the rates. There were at present 1,259 private consumers, and the equivalent of 78,853 8-C.P. lamps connected.

*Johannesburg (Transvaal).*—The Town Council meeting, to which reference was made in our last week's notes, ended in most of the amended tramway routes being decided upon, and recommending the consulting engineers (Messrs. Mordey & Dawbarn) to prepare specifications immediately for cables on that basis.

A very heavy thunderstorm passed over Johannesburg on April 25th, by which an interruption of the electric light supply took place on the portion of the town supplied from Brakpan, causing much inconvenience. During this time of the year storms are of frequent occurrence, and as may be known this supply is brought into Johannesburg by overhead mains at 10,000 volts, the poles looking very formidable across the veldt, with the "skull and cross bones" painted on them.

The *Cape Times* publishes an interesting article on the electrification of steam roads, in which the advantages of electricity over steam are pointed out by the writer, who, incidentally, says:—"I suppose it must be quite 10 years ago that the idea of adopting electricity in place of steam-power on the Cape Town—Simon's Town line was first mooted. In those days electric traction was in its infancy, and traffic on our suburban line was less than half what it is to-day. It was too early at that time of day to consider the question seriously. Now, however, it is clear that unless some means are adopted to relieve the congestion of traffic during business hours on the Cape Town—Wynberg section of the suburban line, it will be impossible for men regularly employed in the city to live anywhere along it. . . . If the substitution of electric for steam traction should be found to solve very similar difficulties in the case of the Liverpool and Southport Railway, which presents many points of resemblance to our own suburban line, it seems highly probable that an equally satisfactory result would follow a like course here."

*Transvaal.*—In the schedule of assets, as at December 31st, 1903, of the Geldenhuis Estate and Gold Mining Co., the value of the electric plant is set down at £16,224. The details are as follow:—11 dynamos, 19 motors, 2 transformers, 22 switchboards, 38 lightning arresters, 1,250 lights, 13 spare armatures, 23 spare field coils, wiring (12 miles), 3 250-H.P. Brunner engines, vertical. The manager reports: "Two new generators for the main shaft have been

erected, and also two small Brunner engines, as auxiliaries for driving the plant."

In the "creditor" side of the annual balance-sheet of the New Primrose Gold Mining Co. is the following entry: "Electric plant, £6,220."

Shareholders in the Potchefstroom Electric Light and Power Co. met in the town mentioned on April 28th, to consider the desirability of increasing the capital of the company, rendered necessary by the acceptance of tenders for town lighting. It was unanimously decided to increase the capital to £12,000; at present it is £6,000. Two additional local directors were elected.

Mr. Hugo Hellman, of the British Electric Co., was among those who were present at the meeting recently held in Johannesburg to discuss the question of Government supplies and the Crown agents.

*Natal.*—At a recent meeting of the Port Advisory Board, Durban, a discussion took place on the failure of the hydraulic cranes to deal with the large vessels now entering the port, and suggestions were made as to whether the whole hydraulic system, which cost £100,000, should not be stopped, and electric cranes substituted. The matter was deferred until the reports on it could be circulated amongst members of the Board.

**Australian Electrical News.**—The *Sydney Daily Telegraph* on April 7th published a dispatch from Melbourne as follows:—"It is probable that coin-in-the-slot telephones will be established in various parts of the chief cities of the Commonwealth at an early date. The conference of electrical experts recently recommended the adoption of the Ericsson attachment, and the Postmaster-General has practically accepted the recommendation. These attachments can be obtained at a cost of 20s. each, whereas those previously used in the Commonwealth, which were made in Melbourne, cost the department £11 17s. 6d. each. A Chicago invention, obtainable at 32s., was also considered, but the Ericsson machine is held to be thoroughly efficient and also cheap."

The inaugural meeting of the 1904 session of the Electrical Association of New South Wales was held in Vickery's Chambers, Sydney, on April 8th. The president, Mr. J. R. Woodruffe Gardam, M.I.E.E., delivered his address. After reviewing recent advances made in electrical science, he dealt at some length with local topics, introducing the much-discussed rate for lighting about to be made by the City Council.

We learn that Messrs. Noyes Bros., of Perth (W.A.), have been appointed engineers to the Fremantle and East Fremantle Municipal Councils to design and construct a complete system of electric tramways for these municipalities, the estimated cost of the works being £84,000. Messrs. Noyes propose to start on the designs almost immediately, and contemplate having the system ready for operation in about 18 months.

**The Preparation of Iodoform from Acetone by Electrolysis.**—J. E. Teeple has studied the formation of iodoform by electrolytic agency from acetone as the raw material. He used an electrolyte composed of 25 to 30 grammes of potassium iodide dissolved in from 200 to 250 cc. of water, mixed with 2 cc. of acetone, and kept in a state of constant agitation by mechanical means. The liquid was held in a deep basin, on the bottom of which a piece of platinum foil 4 square decimetres in area was placed to serve as anode, while a platinum wire dipping just beneath the surface of the bath acted as cathode. A current was passed, having a density varying at the anode from 1 to 6 amperes per square decimetre, the E.M.F. ranging between 3 and 12 volts, according to the concentration and temperature of the solution, to the current density, and to the distance between the electrodes. In order to obtain a good yield it was found necessary to neutralise the alkali which is liberated, immediately it is set free. Carbon dioxide, hydrochloric acid, hydriodic acid, and iodine may be used to do this; the last is the best. Generally speaking, it is also necessary to see that the temperature of the bath does not rise sufficiently high to permit of the formation of much potassium iodate, to keep the liquid in constant circulation so that the dilute iodine solution about the anode may react with the potassium hydroxide at the cathode, and to use a current density low at the anode (so as to discourage the production of iodate) and high at the cathode (so as to prevent the reduction of the hypo-iodite already produced).—*Journal Amer. Chem. Soc.*, 1904, xxvi., 170.

**"First Aid."**—We read in a Manchester paper that Mr. J. A. F. Aspinall, general manager of the L. and Y. Railway Co., on 18th inst., presented certificates and medallions to those of the employés who have been conspicuous in ambulance work, and advised them, in view of the railway electrification movement, to become acquainted with first aid methods of dealing with electrical accidents.

**The Electro-chemical Behaviour of Radium.**—A. Coehn has attempted to obtain deposits containing traces of radium by electrolysing aqueous solutions of barium bromide with the aid of cathodes of different metals. The experiments failed, for in all cases only induced activity was to be observed, without separation of radium. When, however, mercury was employed as the cathode, and when the electrode was washed and dried after interrupting the current, its activity was found steadily to increase to a maximum; and when the amalgam was dissolved in dilute hydrobromic acid, a permanently active bromide was obtained, so that radium must have been thrown down upon the mercury. Deposition of radium occurred excellently upon cathodes of amalgamated zinc. Rods or wires of zinc were coated with mercury and brought into the electrolyte. A current was then passed, so weak that the substance thrown down was too small in quantity to be weighed. The wires were taken out, washed well with distilled water, and dried by means of bibulous paper. The electrometer showed them to be active, and they increased in activity for several days, when they became constant. They brought a crystal of barium platinocyanide to full brilliancy. In order to compare the activity of the substance obtained by electrolysis with that of the original material, the amalgam obtained on a cathode of pure mercury was treated with dilute hydrobromic acid, and then evaporated to dryness. After it had reached its maximum, the activity of such a preparation was always greater than that of an equal amount of the original substance. As a rule, the amalgam was produced more freely from an electrolyte in which the solvent was methyl alcohol than from an aqueous solution. This amalgam of radium and barium is the first body to be produced containing radium in the metallic form. Measurements with the electrometer prove that metallic radium, as well as its compounds, increases in radio-activity for several days, and then attains a maximum.—*Berichte*, 1904, xxxvii., 811.

**Preparation of Alcohol from Acetylene.**—The Société S. Jay & Co., of Paris, have taken out a German patent (No. 149,893) for a method of obtaining alcohol from calcium carbide. 45·6 litres of acetylene and 173 litres of hydrogen are mixed with 540 litres of ozonised oxygen in a strongly cooled apparatus. The liquid which condenses is neutralised with sodium carbonate, and submitted to fractional distillation. The boiling point varies at first between 20° and 55° C., next remains for some time at from 80° to 83° C, and finally rises higher. The distillation is then stopped. The most volatile distillate consists chiefly of aldehyde, which can be precipitated in the form of crystals of aldehyde-ammonia by adding ammonia to it in the cold. These crystals can be reconverted into aldehyde by treatment with sulphuric acid. The original distillate obtained between 80° and 83° C. also possesses the odour of aldehyde, but yields no precipitate with ammonia. It is, therefore, distilled under diminished pressure with sodium bisulphite. The distillate has a specific gravity of 0·804 at 0° C., and boils between 78° and 79·5° C. It is inflammable, and gives the characteristic iodoform reaction. It also yields ether and ethylene on treatment with pure sulphuric acid. The quantity of alcohol obtained is about one-quarter of the theoretical amount.

**Institution of Electrical Engineers (Birmingham Section).**—The annual meeting of this section was held at the University on 18th inst., Mr. Vaudrey presiding. The report showed that the number of members had been increased by seven, associate members by 23, associates nine, students 20, the total increase being 59. The chairman moved the adoption of the report, and said that the section had made very satisfactory progress. Four papers out of five read had been accepted by the Institution in London for publication with the minutes, and thus the local section would be saved the expense of printing them. Dr. Sumpner seconded the motion, and remarked that a membership of 258 was very satisfactory. A vote of thanks was accorded to the Birmingham Small-arms Co. for having allowed members of the Institution to inspect their new power station at Small Heath, and to Mr. Henry Lea for making the arrangements and conducting the party. Mr. F. O. Hunt, an associate member, then read a paper on "Motor-starting Switches and Resistances."

**The Heat Emissivity of Radium.**—According to a paper communicated to the German Physical Society, J. Precht finds that 1 gramme of radium bromide emits 61·15 calories per hour. From the formula Ra Br, and the spectroscopically-estimated atomic weight (258) of the metal, 1 gramme of radium itself should evolve 98·83 large calories per hour. Hence it follows that 6·4 kilogrammes of radium should emit a quantity of heat equal to 1 (German) H.P. The measurements that have hitherto been made agree so well, that the heat emissivity of radium salts is probably of the nature of a physical constant.

**The Spectrum of Radium.**—C. Runge and J. Precht find that the positions of the most conspicuous lines in the spark spectrum of radium are affected by a magnetic field in precisely the same manner, quantitatively as well as qualitatively, as the lines in the spectra of magnesium, calcium, strontium, and barium. The similarity between all five spectra is shown very clearly when their lines are displaced by the action of a magnetic field. Radium, therefore, evidently belongs to the class of alkaline earth metals.

**Calcium Carbide in Germany.**—From a report recently published by a firm of chemical dealers in Dresden, we learn that the price of calcium carbide has remained far more steady during the last year than in preceding seasons. Since the reduction which occurred this spring, carbide has been quoted at about 23 to 26 marks per 100 kilos. The consumption has increased every year in Germany. With reference to this matter, it may be remarked that the death of the central European syndicate a short time ago has upset everybody's calculations, and German consumers of carbide are somewhat anxious about what is going to happen. It is feared that the price may once again fall temporarily to a point which cannot be maintained, which may cause installations for the supply of acetelyne to be erected in unsuitable places, and that the inevitable reaction which will afterwards force the price up to a remunerative figure may disgust many people with the whole business. It has been stated, however, on good authority, that the carbide factories are now able to make carbide at a much lower cost than when the last "slump" occurred, so that the drop of 4 to 7 marks per 100 kilos, which has already taken place, is believed to be quite legitimate.

**London County Council.**—At the meeting on 17th inst., the Finance Committee reported that the Woolwich Borough Council had applied for sanction to borrow £5,000 for the assisted wiring of consumers' premises for electric lighting and the letting out of electric motors on hire. By the Woolwich Borough Council Act, 1903, the Council obtained power to supply and let on hire these fittings, and it is the only metropolitan council empowered to do so. The Borough Council had not furnished information as to how the £5,000 would be applied, and the Committee proposed that the Council should sanction the borrowing of £1,000 on account of the application, leaving the borrowing of any further amount to be approved upon receipt of particulars of the expenditure out of the £1,000. It appeared from the scale of charges adopted by the Borough Council that the original outlay would be repaid by the consumer within a maximum term of eight years, and on the recommendation of the Finance Committee, it was resolved to fix the period of repayment of the £1,000 at eight years.

*Municipal Wiring.*—The Highways Committee submitted a report reminding the Council of the insertion in the General Powers Bill of 1902, of clauses to enable local authorities to wire and fit consumers' premises for electric lighting, and to obtain loans for this purpose. The clauses, which were struck out on second reading, were also included in the Council's General Powers Bill of 1903, but on the second reading, the House of Commons, by 126 votes to 109, passed an instruction to the Select Committee to which the Bill was referred to delete the clauses. The Committee proceeded to state:—"Since then representatives of the London local authorities interested have met in conference upon this matter, and appointed a deputation to attend before us and urge that the Council should again make an effort to obtain for the borough councils the desired powers. The deputation informed us that the local authorities supplying electrical energy were placed under a very serious disability owing to their not being authorised to undertake the additional services above referred to. They, moreover, pointed out that both electric lighting and gas companies possessed such powers, and, being thus enabled to make advantageous terms for the supply of fittings to consumers, were placed in a more favourable position than the local authorities. The deputation stated that this difficulty pressed with peculiar hardship upon the local authorities supplying electrical energy in the poorer districts of London, as consumers in such districts had greater difficulty, on account of the initial expenditure, in arranging for electric lighting installations at their premises. The Woolwich Metropolitan Borough Council obtained an Act in 1903, conferring these powers upon it, so far as regards that borough, but there are a large number of other metropolitan borough councils supplying electricity, but not having powers to supply fittings, &c., although the majority are very desirous of doing so. The deputation urged, therefore, that it was desirable, on the grounds both of convenience and of economy, that another effort should be made by the Council to secure clauses conferring the necessary powers upon local authorities, as, should the Council take this course, the necessity for the promotion of a Bill for the purpose, by each of the different local authorities interested would be avoided. Having regard to the very strong views expressed on behalf of the local authorities as to the desirability of clauses dealing with the matter being included in one of the Council's Bills next session, we feel it our duty to suggest to the Council that it should again seek the powers referred to." When the same proposal was before the House of Commons in 1903, it was urged that the powers sought could only, if at all, be justified in the case of borough Councils possessing electric lighting undertakings or powers to establish works, and the deputation who attended before the Highways Committee suggested that, in the present instance, the clauses should be made to apply only to such authorities as have, or may obtain, powers to supply electrical energy. The Committee concurred in this view, and on their recommendation the Council resolved to apply to Parliament in the session of 1905 for powers in the direction indicated.

Approval was given by the Council to an expenditure of £22,190 for the erection of car-sheds at Camberwell, and to a supplementary estimate of £4,500 for work in connection with the reconstruction of the Tooting—Westminster tramways.

**Light Railways Act, 1896.**—The Board of Trade have made an additional rule, under the above-named Act, with respect to the notices to be given and deposits made in cases where alterations of works are proposed during the progress of an application for an Order. The rule reads as follows:—

"Where an application for an Order authorising a light railway has been made to the Light Railway Commissioners and the promoters communicate to the said Commissioners their desire to make any additions to or alterations in the line of the railway or the works thereof or the lands to be taken as respectively proposed under such application, and such desired additions or alterations are not of such extent or character as to make it inconvenient or inadvisable in the opinion of the Commissioners that the same should be dealt with under the said application, the promoters shall with the consent of the Commissioners given at any time before the said application has been decided on by them, publish such advertisements and give such notices and make such deposits (including any lists and statements required under Rules 32 and 33 of the Board of Trade Rules, 1898) as would have been requisite under the said rules if such additions or alterations had formed the subject of a separate application for an amending order in accordance with Rule 38 of the said rules except that notwithstanding anything contained in the said rules, such advertisements shall be published, such notices given, and such deposits made at such times as shall be directed by the Commissioners.

"Francis J. S. Hopwood,

"*May*, 1904. *Permanent Secretary, Board of Trade.*"

**The American and English Mechanicals' Joint Meeting.**—The American Society of Mechanical Engineers and the English Institution of Mechanical Engineers are to hold a joint meeting at Chicago, commencing next Tuesday, and continuing until June 3rd. Among the papers down for consideration are the following:—

Emerson, Harrington: "The Wages Problem."
Watson, George: "Some Recent Examples of Destructors for Town Refuse."
Russell, C. Newton: "Refuse Destruction by Burning, and the Utilisation of Heat Generated."
Hodgkinson, F.: "Some Theoretical and Practical Considerations in Steam Turbine Work."
Lea, E. S., and Meden, E.: "The De Laval Steam Turbine."
Emmet, W. L. R.: "The Curtis Steam Turbine."
Rateau, A.: "Different Application of Steam Turbines."
Kerr, C. V.: "The Potential Efficiency of Prime Movers."
Wells, J. H.: "Power Plant of the Tall Office Building."
Bolton, R. P.: "Power Plant of Tall Office Buildings."
Raven, Vincent L.: "Middlesbrough Dock Electric and Hydraulic Power Plant."
Marks, Lionel S.: "Use of Superheated Steam and of Reheaters in Compound Engines of Large Size."
Flint, Wm. P.: "Commercial Gas Engine Testing and Proposed Standard of Comparison."
Nicolson, J. T.: "Experiments with a Lathe-Tool Dynamometer."

**The Board of Trade and Tramway Accidents.**—The official circular of the Tramways and Light Railways Association for May publishes the following letter, which has been received from the Board of Trade on the subject of tramway accidents:—

*March 21st*, 1904.

With reference to the forms which have been prescribed by this Department for the return of electrical and general accidents occurring on tramways and light railways laid on public roads, I am directed by the Board of Trade to inform you that these returns have furnished them with much valuable information, and that, as a result of the experience so obtained, the future reporting of accidents to the Department may be modified in accordance with the further instructions in the enclosed memorandum.

The Board attach great importance to the regular forwarding of the prescribed reports, and regret to have reason to believe that all tramway and light railway authorities have not been equally careful in fulfilling this requirement. In view of the restriction now placed on the number of reportable accidents, it is hoped that, in future, the returns may be forwarded in all cases.

(Signed) Herbert Jekyll.

Tramways and Light Railways laid on Public Roads.
Memorandum on the Forms of Return of Accidents to the Board of Trade.

*a.* Electrical.

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|---|---|
| 1a. Guard wire pulled down by trolley<br>1b. Trolley wire pulled down by trolley<br>1c. Overhead wire broken by trolley<br>2. Guard wire falling on trolley wire<br>6. Failure of insulation | To be reported only if causing injury to any person, or if accompanied by heavy short circuit, or alarming result. |
| 1d. Trolley head pulled off | To be reported if causing personal injury. |
| 1e. Standard damaged by trolley jumping<br>1f. Trolley boom broken<br>1g. Miscellaneous damage done by trolley jumping | To be reported if causing or likely to have caused personal injury. |
| 1f. Trolley boom pulled out | Should be reported in all cases. |
| 4. Trolley wire breaking and falling | |
| 7. Other classes of accident | Burning out of fields, failure of controller, &c., need not be reported unless causing or likely to have caused personal injury or alarming result. |

*b.* General.

As regards the classes of accidents numbered 1, 2, 4, 5 and 6, those cases only should be reported which result in personal injury or serious damage to cars or other vehicles.

All cases of cars running away should be notified, whether such accidents result in personal injury or not.

**Tramcar Construction.**—The following is a copy of the memorandum on details of construction forwarded to the Light Railway and Tramway Association by the Board of Trade on May 12th, 1904:—"The space between the inner rails of a double line must depend upon the overhang of the cars. It is, however, necessary that there should be at least 15 in. between the sides of the passing cars, and also a similar space between the side of a car and any standing work, such as lamp-posts, telegraph posts, and trolley wire standards in a street. As a rule, there should be at least 15 in. between the side of the car and the kerb, whether on straight or curved roads. Where central poles are used for electric traction, any stone kerbing should not be left wide enough at the sides facing the rails to enable any person to stand upon it as a refuge.

"For mechanical traction it is generally considered that the weight of rails should not be less than 90 lbs. per yard, 100 lbs. being preferred. The groove of the rail should not exceed *one and an eighth inch* in width, but the Board of Trade are prepared to accept a groove not exceeding *one and a quarter inch* on curves of less than one chain radius.

"Staircases of the 'reversed' type should be avoided, more especially on narrow-gauge lines. Of existing types, the 'trigger' life-guard is the pattern which is preferred. The hanging gate should be as close to the ground as possible, and there should be at least 3 ft. between it and the front of the guard. Both the guard and the gate should be at least as wide as the outside of the frame of the truck. In order not to interfere with the efficiency of the life-guard, it is desirable that folding steps should be adopted on all new cars. Where trolley ropes cannot be dispensed with or tied up, precautions must be taken to prevent the 'slack' causing accidents. To prevent trolley booms being pulled out, or trolley standards broken, 'traps' should be minimised and detachable trolley-heads provided.

"Board of Trade, *January*, 1904."

**Appointments Vacant.**—A professor of civil and mechanical engineering is wanted for London University at £1,000 per annum, in succession to Prof. W. C. Unwin, F.R.S.; an assistant lecturer in engineering (£150) is required by the Swindon Educational Committee; tramways manager for Durban (£600); shift engineer for Eastbourne (£104); charge engineer for Bristol electricity works (50s. to 60s.).

**Johnson & Phillips, Ltd.**—It will interest our readers to learn that the prospectus of this company, which has been formed to take over the business of the well-known firm of Johnson and Phillips, of Charlton, will shortly be placed before the public. The nominal capital of the company will be £400,000 in £1 shares (half 6 per cent. cumulative preference, and half ordinary), and there will also be £100,000 in 4½ per cent. first mortgage debenture stock. The purchase price will be £450,000, payable as to £315,000 in cash, £25,000 in debentures, and £55,000 in each of the ordinary and preference shares. The issue, which will shortly be offered for subscription, will be as follows:—£75,000 debentures, £145,000 preference, and £145,000 ordinary. We understand that the net profits for the past four years have averaged £81,593 per annum, on an approximate turnover of £300,000. We may add that the directors of the company will be as follows:—Robert W. Blackwell, Sir Henry Benbow, K.C.B., D.S.O., Henry J. Wagg, J. Macgregor, and S. Paterson. The last two gentlemen are to be managing directors.

## OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the power station or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.*]

**Central Station Engineers.**—Mr. W. J. R. BAKER has resigned the position of assistant superintendent of the electric fittings department at the Bolton Municipal Electricity Works.

Mr. W. L. VITTY, of Dudley Corporation Electricity Works, has been appointed assistant mains superintendent at Partick.

A smoking concert was held at the Royal George Hotel, George Street, Chester, on Wednesday, May 18th, when Mr. THURSFIELD, the retiring chief, was presented with a silver rose bowl and a pipe. The presentation was made by Mr. A. DIMMACK, chief assistant, who expressed the regret of all the employés that Mr. Thursfield was leaving them. Mr. Dimmack has been made responsible until the new chief (Mr. BRITTON) takes up his duties.

The following increases of salary in the Glasgow Electricity Department have been passed by the T.C.:—Mr. R. B. MACCALL, chief clerk, from £275 to £300; Mr. WILLIAM L. LACKIE, chief assistant, from £475 to £500; Mr. W. T. CALDERWOOD, chief draughtsman, from £225 to £250.

Devonport T.C. has increased the salary of the electrical engineer (Mr. J. W. SPARK) from £250 to £300 per annum, and that of Mr. STAMP, assistant electrical engineer, from £130 to £150 per annum.

**General.**—We have to announce that Mr. A. G. CHURTON, representing Messrs. Fuller, MacLeod & Co., Ltd, of 9, Red Lion Court, Cannon Street, E.C., will sever his connection with this firm at the end of the present month, to join the firm of Messrs. Bergtheil & Young, in their motor and motor fan department.

The Hart Accumulator Co., Ltd., ask us to say that Mr. F. R. HILL, who was recently in their employment as a traveller, does not now represent them.

Mr. A. J. G. SIMPSON, manager in Cape Town, of the firm of Siemens, Ltd., electrical engineers, and son of the late Mr. James Simpson, general manager of the Bank of Africa, was lately married at St. John's Church, Wynberg, just outside Cape Town, to Miss Marie de Witt, only daughter of Mr. and Mrs. Anthony de Witt, of Montana Vista, Wynberg.

The *Times* announces the engagement of Mr. REGINALD K. MORCOM, eldest son of Mr. Alfred Morcom, of Birmingham, and Miss Isobel Swan, third daughter of Dr J. Wilson Swan, F.R.S., of London.

We learn that Mr. H. M. HARRIS, of Harris, Lee & Co., electrical engineers, Johannesburg, is leaving for South Africa on the 28th inst. by the *Kenilworth Castle*.

The Glasgow Corporation has appointed Councillors GIBSON and WILLOCK to attend, along with the engineer, the annual meeting of the Municipal Electrical Association, to be held in Derby, Nottingham, and Sheffield on June 29th and 30th, and July 1st and 2nd next.

We regret to record the death of Mr. CONSTANTINE M. HOOPER, who was formerly secretary of the West India and Panama Telegraph Co. Mr. Hooper passed away suddenly at Weymouth, on 16th inst., at the age of 56.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**Woking Electric Supply Co., Ltd.** (46,175).—Issue, on April 23rd, of £800 debentures, part of series created November 2nd, 1899, to secure £15,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £28,550.

**National Telephone Co., Ltd.** (15,066).—This company's annual return, made up to March 3rd, was filed on April 5th. The capital is £6,000,000 in 15,000 first and 15,000 second preference shares of £10 each, 250,000 third preference and 100,000 ordinary shares of £5 each, £1,983,333 6s. 8d. preferred stock, and £1,966,686 13s. 4d. deferred stock, of which all the first, second and third preference shares, and preferred and deferred stock, have been taken up. £10 per share has been called up on 12,220 first preference and 15,000 second preference, and £5 per share on 221,716 third preference shares, and the full amount on £1,264,660 preferred and £529,320 deferred stock. £3,174,760 has been received. £2,325,240 is considered as paid on 2,780 first and 28,284 third preference shares, and £715,673 6s. 8d. preferred and £1,437,346 13s. 4d. deferred stock. Mortgages and charges: £2,689,593.?

**St. James's and Pall Mall Electric Light Co., Ltd.** (26,015).—This company's annual return was filed on March 9th, when the entire capital of £300,000 in 40,000 ordinary and 20,000 preference shares of £5 each had been taken up. £5 per share has been called up on 39,650 ordinary and 20,000 preference shares, resulting in the receipt of £298,250. £1,750 is considered as paid on 350 ordinary. Mortgages and charges: £150,000 3½ per cent. debenture stock and £145,691 4 per cent. guaranteed debenture stock of the Central Electric Supply Co., Ltd. (being half the total loan capital).

**British Westinghouse Electric and Manufacturing Co., Ltd.** (62,919).—This company's annual return was filed on March 23rd, when 400,000 preference and 75,000 ordinary shares had been taken up out of a nominal capital of £3,250,000 in 500,000 preference shares of £5 each, and 75,000 ordinary shares of £10 each. £5 per share has been called up on the preference shares, resulting in the receipt of £2,000,000. £750,000 is considered as paid on the ordinary. Mortgages and charges: £616,353.

**Chelsea Electricity Supply Co., Ltd.** (20,460).—Particulars of a series of debentures, created by resolution on March 5th, 1895, to secure the nominal amount of the share capital for the time being issued (now £252,680), have been registered pursuant to Section 14 (4) of the Companies Act, 1900. Property charged: The company's undertaking and property, present and future. No trustees: The debentures are issued to trustees for holders of debenture stock (limited to same amount), acting under a trust deed dated March 6th, 1895.

**Westminster Electric Supply Corporation, Ltd.** (27,061).—This company's annual return was filed on March 24th, when 110,000 ordinary and 28,151 preference shares had been taken up out of a nominal capital of £800,000 in £110,000 ordinary and 50,000 preference shares of £5 each. £5 per share has been called up, and £690,755 has been received. Mortgages and charges: £250,000.

**Telegraph Construction and Maintenance Co., Ltd.** (1,147 C).—This company's annual return was filed on March 24th, when the entire capital of £148,500 in £12 shares had been taken up and paid in full. No mortgages or charges.

**Langdon-Davies Motor Co., Ltd.** (55,830).—Issue, on April 29th, of £200 4½ per cent. debentures, part of series created October 15th, 1902, to secure £6,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £5,800.

**Woking Electric Supply Co., Ltd.** (46,175).—This company's annual return was filed on April 15th, when 18,870 preference and 15,859 ordinary shares had been taken up out of a nominal capital of £50,000 in £1 shares (25,000 preference). £1 per share has been called up. £34,479 has been paid. £250 remains in arrears. Mortgages and charges: £22,600.

**Longstreths, Ltd., electricians,** London (64,823).—Issue to M. Greenberg, of 8, Water Lane, E.C., by way of collateral security only, of £1,200 debentures, part of series created May 6th, 1904, to secure £2,000, charged on the company's undertaking and property, present and future, including uncalled capital. Date of issue: May 7th, 1904. No trustee. No previous issue of same series.

## ELECTRICITY SUPPLY ACCOUNTS.

**Accrington Municipal Electricity Supply.**

THE results for the year's working of the Accrington undertaking show a steady increase in output and revenue, compared with previous years. Gross working expenses show a decrease on the average, and the increased revenue (£1,005 higher than last year) has produced a corresponding improvement in the financial position of the concern. The units sold, 254,309, represent an increase of 44 per cent., and of this number it is satisfactory to note 34 per cent. were for power. The average price obtained for all kinds of supply was 3·66d. per unit.

The undertaking is worked in conjunction with a refuse destructor, and 48 per cent. of the fuel costs are for heat supplied by the latter.

The prices charged are:—Private lighting, 4d. per B.T.U.; power, 3d. and 1d. with discount; power for destructors, 2d.; public lighting, 3d. The chief engineer is Mr. H. Gray.

GENERAL STATEMENT.

| For year ending March 31st— | 1904. | 1903. |
|---|---|---|
| Total capital expended ... ... ... | £44,528 | £42,516 |
| Number of units sold— | | |
| Private supply ... ... ... ... | 209,987 | 146,816 |
| Public lighting ... ... ... ... | 20,204 | 9,988 |
| Contract destructors ... ... ... | 24,118 | 19,080 |
| Total number of units sold ... | 254,309 | 175,884 |
| Equivalent No. of 8-c.p. lamps connected | 21,635 | 16,798 |
| No. of motors connected ... ... ... | 29 | 25 |
| Number of public lamps ... ... ... | 9 arc<br>57 Nernst | 9 arc<br>32 inc. |
| Maximum load in KW. ... ... ... | 238 | 194 |
| Revenue account— | | |
| Gross revenue ... ... ... ... | £3,884 | £2,878 |
| „ expenditure ... ... ... | £1,964 | £1,552 |
| „ profit ... ... ... ... | £1,920 | £1,326 |
| Average inclusive price obtained per unit— | | |
| Private supply ... ... ... ... | 3·5d. | 3·82d. |
| Public lighting ... ... ... ... | 3d. | 3d. |
| Contract, destructors ... ... ... | 2d. | 2·04d. |

REVENUE ACCOUNT FOR YEAR ENDING MARCH 31ST, 1904.

| | | |
|---|---|---|
| Gross revenue ... ... ... ... | £3,884 = 3·66d. | per unit. |
| Works and distribution costs (including public lighting) ... ... ... | £1,261 = 1·19d. | „ |
| Total working costs ... ... ... | £1,964 = 1·85d. | „ |

PROFIT STATEMENT.

| | |
|---|---|
| Interest on loans ... ... ... ... ... | £1,204 |
| Sinking fund ... ... ... ... ... ... | 1,592 |
| Debit balance charged against local rate ... ... | −876 |
| Gross profit ... ... | £1,920 |

**Leeds Municipal Electricity Supply.**

THE returns of the Leeds electrical undertaking show a rapid expansion in output during the past year. The figures for the past five years are:—1900, 2,005,840; 1901, 2,520,114; 1902, 3,055,165; 1903, 4,448,650; and 1904, 6,271,186 units. It is satisfactory to note that motive power supply is developing, although Leeds still lingers far behind its neighbour, Bradford, in this respect.

With the improved conditions prevailing, a gross profit of £49,537 was made, as compared with £36,660 last year, and a balance of £3,430 remains after meeting financial obligations. The working costs stand at 1d. per unit, including expenses incidental to changing over the system of supply.

The prices charged are:—Private lighting, 4d. per unit, less 5 per cent. discount; power, &c., 2d. to 1½d., with discounts; public lighting, 1½d. net. The chief engineer is Mr. H. Dickinson.

GENERAL STATEMENT.

| For year ending March 25th— | 1904. | 1903. |
|---|---|---|
| Total capital expended ... ... ... | £752,509 | £671,411 |
| Number of units sold— | | |
| Private and public lighting ... ... | 6,271,186 | 4,448,650 |
| Equivalent No. of 8-C.P. lamps connected | 307,849 | 231,734 |
| Number and H.P. of motors connected ... | 636 = 2,903 H.P. | 382 = 1,437 H.P. |
| Number of public lamps ... ... ... | 122 | 93 |
| Maximum load in KW. ... ... ... | 5,040 | 4,126 |
| Revenue account— | | |
| Gross revenue ... ... ... ... | £75,721 | £56,014 |
| „ expenditure ... ... ... | £26,184 | £19,354 |
| „ profit ... ... ... ... | £49,537 | £36,660 |
| Average inclusive price obtained per unit— | | |
| Private and public lighting ... ... | 2·90d. | 3·02d. |

REVENUE ACCOUNT FOR YEAR ENDING MARCH 25TH, 1904.

| | | |
|---|---|---|
| Gross revenue ... ... ... | £75,721 = 2·90d. | per unit. |
| Works and distribution costs ... | £17,033 = 0·65d. | „ |
| Total working costs ... ... ... | £26,184 = 1·00d. | „ |

PROFIT STATEMENT.

| | |
|---|---|
| Interest on loans, &c. ... ... ... ... | £26,087 |
| Sinking fund... ... ... ... ... ... | 20,020 |
| Balance carried forward ... ... ... ... | 3,430 |
| Gross profit ... | £49,537 |

# CITY NOTES.

## Elmore's German and Austro-Hungarian Metal Co.

MR. J. MACFARLAN (Chairman), presided on Thursday last week, over the annual meeting of this company at Winchester House. He said that trade on the Continent had been far from flourishing, and the result had been that they had to compete in the world's markets for orders at prices which were much lower than those they received from inland customers, and the output had of necessity to be decreased, but the period of depression was now fast disappearing, and they were to-day in the position of having as many orders as they could conveniently deal with at prices above those of the past year. Given ordinary times and conditions there was no reason why dividends should not be earned. If they compared the accounts for some years past they would understand the uphill work it had been to bring the company to its present position. The company had always been burdened with a heavy charge for interest and had to expend out of profits a considerable amount of money in bringing the process to its present state of efficiency. It had also had to depreciate heavily, and it had also been the policy of the board to govern the business on conservative lines. Many items had been charged to revenue which might well have been charged to capital account. They had made many improvements in their patents, and the latest, the circulation patent, was perhaps the most important of all; but nothing whatever had been charged to capital in respect of their value, not even the cost of obtaining them. The only addition that had been made to patent account was an item which appeared in the Metall Co.'s accounts this year, and this represented the actual amount paid for the sole rights for the production of copper tubes in Germany by the new process. The most disappointing aspect of the company's business was the constant decrease in the margin between the cost of raw material and the selling price. Since the company started in Germany others had sprung up and so rendered competition very keen, with the result that the margin had decreased in the last twelve years by no less than £15 per ton. Their sales last year were approximately 1,000 tons, and, therefore, had the old prices remained, their profits would have been large and the estimate originally made fulfilled. They had, however, to face the position as it was, and had devoted themselves to reducing the cost of production, and with a fair amount of success. It was a matter of regret that he could not tell them that day that their new machine was at work producing tubes. Delivery was promised for January last, but it was not until the end of April that the last consignment was delivered. They anticipated economies from this machine, and would leave no stone unturned to make it a thorough success. They would carefully check the cost of production, and after a fair trial would report the result. He could truly say that the financial position of the company was never so sound as now. The depreciation of the manufactured and partly (manufactured) articles in hand seemed to be both necessary and wise. Notwithstanding (1) the large sum they had spent in various ways, (2) the decrease in the debts of the Metall Co., and (3) the increase in the amount due to the Metall Co., making a total of £11,300, the liabilities had only increased by £3,875. He saw no reason why, under present conditions, apart from the probable profits of the new machine, the company should not pay its way by the Elmore process alone, and this belief was strengthened by the fact that they had reason to hope that an arrangement would be come to very shortly by the various tube-makers of Germany whereby price-cutting in the future would be avoided. The directors had had under consideration the question of patents. The first of the patents originally purchased by the company had now lapsed by effluxion of time, and it was desirable that the amount of the patent account should be reduced very considerably, and also that the amount standing to the debit of profit and loss should be removed, so that the company could resume the payment of dividends which, since 1901, had not been paid. The directors did not propose to take any steps this year in this direction, but to leave the question open until after the new machine had had a fair trial. They would also have to ask the debenture-holders to further postpone the repayment of the debenture stock, as it would not be to the advantage of the company to deal with the conversion at the present moment.

MR. J. HEAL seconded the adoption of the report.

MR. DUNCAN, chairman of the English Elmore Co., expressed the opinion that good would result from a closer intercourse between the companies, so that they might learn the results of each other's experience.

MR. ELLIS, managing director, said that the position was that the company had spent a large sum of money in experiments, and claimed that they could produce better tubes than other companies. They had shown to the world what they could do, and until the English company had done the same, they were justified in saying they were a little bit better than the latter.

The report was adopted.

## Callender's Cable and Construction Co., Ltd.

THE annual meeting was held on Thursday of last week at Hamilton House.

MR. HENRY DRAKE, in moving the adoption of the report, said that the output of the factory had been a little in excess of that of the previous year. Severe competition was still experienced in all branches of the company's business, so that the prices obtainable had been still further reduced, and left a small margin of profit. Their property at Erith had been valued by Messrs. Bramwell and Harris on March 31st last at £318,951 9s. 1d. The value of the freehold land, buildings, and machinery, on March 31st, 1902, was £300,884 15s. 3d. During 1903 additions had been made of the value of £29,546 15s., which brought the total value up to £330,431 10s. 3d. From that had to be allowed £11,480 1s. 2d. for depreciation, which brought the total down to £318,951 9s. 1d. They would see from the accounts that the item "goodwill and patents" stood at nil, which was satisfactory, for it meant that all sums paid in respect of patents had been paid out of profits. The stock in hand at Erith was worth £101,039 3s. 1d., and was made up as follows:—Raw materials, £85,125 7s. 6d.; manufactured goods, £15,913 15s. 7d. The expenditure on contracts in course of execution, and on patterns, was £98,259 11s. 5d. The item, cable drums, was the same, £20,980 9s. 10d. There was one item they would like to see disappear—"sundry debtors"—which stood at £160,808 7s. 2d. Money retained by corporations for due fulfilment of contracts, amounted to £99,482 15s. 9d. The purchase of shares, and the expenses connected with the acquiring of the Anchor Cable Co., had taken £37,250 8s. 2d. and £35,446 2s. 9d., had been advanced as working capital. He had been looking back over the past history of the company, and found that during the eight years of its existence the average profits worked out at £46,146, so that the profits for the year 1903—£46,456—was rather above the average. With regard to the Anchor Co. it had been decided to keep it as a separate company for the present. It had not been a prosperous company, but in the past it had affected them considerably.

MR. T. O. CALLENDER, in seconding the motion, said that the year's work had been a very difficult one, owing to two causes, the financial stringency and the shocking weather. Owing to the financial stringency, local authorities had found it difficult to continue expenditure on new works for the supply of electricity. Competition had again been keen, and he was afraid that many contractors had taken on work at prices that would not repay the money outlaid. The company was fortunate in having a number of

large contracts on hand, and in spite of the bad times the works had been kept going during the year. However, things were beginning to turn, and already an improvement was noticeable, competition had slackened a little, and the position was more favourable than that of last year. If things kept well they hoped to have a better result to lay before the shareholders at the next meeting; but they had some keen fighting in front, for their adversaries, though few, were very strong. With regard to the shocking summer they had had, a rainy day often meant a loss of from one to two hundred pounds to the company. They had had a lot of work going on in the Thames valley, and on several occasions they had had to knock off work. Partly laid cables had been submerged, and in some cases work had had to be done over again, which meant endless worry and great cost. In addition to the loss in outside contracts, heavy rains had two or three times flooded them out at Erith, where the works were situated on the marsh. There, however, provision was being made to deal with the matter. Altogether the out-of-pocket expenses of the company caused by rains had been somewhere about £10,000. As to the Anchor Co., it was started in the north of England two years ago, and after a year of working the crisis came, and the directors resolved to dispose of the company. In the end his company decided to purchase, and he thought that it would turn out to be a very valuable addition. The Anchor Co. had a very decent rubber connection with small houses, which would be a great advantage to the company. The works were most excellently arranged, some of the founders of the company having previously been with that (Callender's) company. It was being run as a separate concern, as there were some contracts which they wished to finish before making the companies into one concern. He believed that there would be very considerable profits from the undertaking.

The report was adopted, and payment of a dividend on the ordinary shares at the rate of 10 per cent. for the year, and a bonus of 2½ per cent., was agreed to.

Sir David Evans, K.C.M.G., the retiring director, was re-elected, and the proceedings terminated.

## The Typewriting Telegraph Corporation.

THE directors' report for the year ended September 30th, 1903, reads as follows:—

The directors beg to submit the accounts for the past year which show a debit balance of £2,555 7s. 10d. on the revenue account of the year. It will, however, be seen that a sum of £2,259 14s. 10d., which was the net sum realised by the sale of the German patents, has been passed to the credit of capital account. The deficiency on the revenue account will be still further reduced by the amount of the royalties on the German sales, which are not yet ascertained. The expenses, which during the year have been exceptionally heavy, include (under the heads of law and travelling expenses), at least £700, which will not be incurred in the current year. The sale of our instruments for the year show a material increase, and amount with royalties to £4,161 7s. 10d. The terms of the agreement with the Exchange Telegraph Co. practically prevent the corporation from selling the instruments in the United Kingdom, except to the General Post Office. The board has no doubt that a good home trade could have been established but for the conditions in that contract.

The shareholders of this corporation at their last annual meeting, appointed Messrs. Fearn, Daddo and Strode to meet the directors of the Exchange Telegraph Co. on the subject of the said agreement. The meeting took place, but the result was as unsatisfactory as those of the previous conferences of your board with the directors of that company. The relations between this corporation and that company are therefore still most unsatisfactory. The relations between the General Post Office and this corporation are excellent, but the amount of business done with that department is far too limited. The value of the agreement of this corporation with the Exchange Telegraph Co., and with the National Telephone Co. respectively, has proved to be illusory, no business having been done with either of those companies. Further useful improvements in the instruments have been made, and some of these have been patented. There are other improvements emerging from the experimental stage which are expected to increase very greatly both power and speed. Successful demonstrations of the practical utility of the instruments have been made by our staff in Austria, France, the United States and Sweden, which have resulted in the opening of negotiations for the sale of several of these patents. Successful demonstrations have also been made by the Italian and by the Spanish War Office authorities.

The application which your directors have made to the Stock Exchange Committee for the special settlement in the shares on this corporation was duly granted. Your directors are of opinion that it has been conclusively demonstrated that owing to the original contract with the Exchange Telegraph Co. (one of the vendors), it is impossible for the corporation to carry on a home trade at a profit, and further that the want of such home trade materially affects the prospects of the corporation as to the profitable sale both of the foreign patents and of its instruments abroad.

In accordance with the articles, Messrs. G. H. Chantrey and R. W. Nash retire. Mr. Chantrey does not offer himself for re-election; Mr. Nash, being eligible, offers himself accordingly. Mr. E. Liebmann, while manager of the corporation, handed in a notice that at the general meeting he would be nominated for a seat on the board, with a request to appoint him managing director. The board is determined not to accept Mr. Liebmann as a director.

NOTE.—Mr. King, who represents the Exchange Telegraph Co. on this board, of course does not agree with this report.

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The annual meeting was held on Wednesday at Winchester House, Mr. A. J. PARKER presiding. In proposing the adoption of the above report, he said there was a debit balance for the year of £2,555 7s. 10d. That was a regrettably large sum, but they must not consider from that that the Corporation was that amount worse off than it was at the beginning of the year, because that was certainly not the fact. The net loss for the year was £259 13s., and the corporation had one foreign patent—the German—less to sell, but it had received some royalties in respect of the German sales, the amounts of which had not yet been ascertained. He did not think that the result was one of which they could be proud, or even satisfied with, but they would see that the patents at cost amounted to £55,245, an amount which would have to be dealt with at some future period. In their opinion the time to deal with that matter had not yet arrived. It would be very easy to write down considerably the book values of these patents, but to do that and no more would be useless, and to do more would be impossible until they applied to the courts to reduce the capital, and that would be foolish at the present moment. When it could be shown that on the year's transactions the profits really made were in excess of the expenditure, then, and not until then, would any alteration of the capital or the value of the patents be of any practical use to the shareholders. No dividend could be paid, according to law, until it was earned, and the directors had no desire to go against the law or to get it altered. His private opinion as to the value of patents was that, in consequence of the scandalously unfair terms of the contract with the Exchange Telegraph Co., the real value of the patents in the United Kingdom were reduced by at least 75 per cent., and of the foreign patents by at least 50 per cent. The sales, together with royalties, had amounted to £4,161—an increase over last year. As he had before remarked, the results were disheartening to the directors and unsatisfactory to all. The sales during the year showed a material increase, but they had no increase in the home trade to report—practically the whole of the sales being in foreign countries. An endeavour had been made to induce the Exchange Telegraph Co. to modify the terms of the contract, and a conference took place between the two boards with that object, but he was sorry to say that the Exchange Co. would not agree to anything towards that end. As to the future, it was impossible by amicable means to induce the Exchange Telegraph Co. to modify their agreement, and unless and until that agreement was cancelled it would not be possible for the corporation to carry on a home trade of any considerable extent. Their relations with the Post Office were very friendly, but the amount of business done was very small, and far too limited to be of any practical use to the company. The chairman then dealt at considerable length with the dismissal of Mr. E. Liebmann, the former managing director, owing to the unsatisfactory way in which he alleged he had acted for the corporation abroad. Mr. Liebmann had handed in a notice announcing that he would be nominated for a seat on the board, but he (the chairman) wished to state that the board were determined not to accept that gentleman as a director.

Mr. G. H. CHANTREY seconded the resolution.

Mr. LIEBMANN, in a long speech, defended his own position as manager, and said that in his efforts to further the interests of the corporation he had been thwarted by the disagreement which existed on the board as to whether the company should be carried on. It was, he said, true that he only held five shares, but his friends were interested in the corporation to the extent of £2,000, and he had spent much of his own money on his journey to South Africa on the business of the company.

Mr. FERN said it was not to the interests of the shareholders that these matters should be discussed publicly, but he would suggest that a committee should be appointed to confer with the board, and to report thereon to another meeting.

The CHAIRMAN remarked that the board were quite prepared to accept an independent committee if it was the desire of the shareholders. If that were done, the accounts could be brought up to date, but he was afraid the only difference would be, that it would be found that the sales during the last six months had not been so good as those of the preceding six months.

This suggestion was not acted upon, and the discussion was continued.

Replying to a question, the CHAIRMAN said that Mr. Liebmann was under notice of dismissal, which would expire in six weeks' time, but, in the interval, he was not to do any business for the corporation.

Eventually the meeting voted for the adoption of the report, which the chairman declared to be carried, although his ruling was objected to by several shareholders.

Mr. R. W. NASH, the retiring director, was re-elected, but Mr. Liebmann's nomination for a seat on the board was not proceeded with.

The auditors were re-elected, and the proceedings, which lasted nearly 2½ hours, terminated with a vote of thanks to the chairman.

## Willans & Robinson.

ON Wednesday afternoon a meeting of debenture stockholders was held at Cannon Street Hotel, Mr. Rhodes Cobbe presiding, to consider a resolution appointing Mr. J. F. Robinson, M.I.C.E., M.I.M.E., of 17, Victoria Street, S.W., a trustee in place of the late Mr. Frederick Gordon. Mr. Mark Robinson (the chairman of the company) made an explanation respecting the business before the meeting, and said that it might prevent misunderstanding if he mentioned that Mr. J. F. Robinson was not a relative of his.

The appointment having been moved and seconded, Mr. PERCY HUNT asked Mr. J. F. Robinson if, before the matter was put to the vote, he would say whether he approved of the policy of the board with regard to borrowing money against capital for carrying on the business of the company. Could not the position of the company's affairs be remedied by getting rid of the incubus of the Queen's Ferry works, which had cost them such an enormous sum of money? Would he agree to some such drastic measure?

In reply, Mr. J. F. ROBINSON said that this was not a question for the trustees of the debenture holders, but for the directors. The trustees were appointed for a special purpose, and that alone. They had nothing to do with the general affairs of the company; but he would say that he had the honour of being chairman of the advisory committee which discussed what was to be done with the Queen's Ferry Works, and the course of cutting down all unnecessary expense there, and proceeding solely and simply with the manufacture of the boilers until they could see whether the boilers could be manufactured at a profit, met with his personal support, and that of the whole advisory committee.

The resolution was carried unanimously. Proxies to the value of £95,620 had been laid on the table.

## Nernst Electric Light, Ltd.

A CIRCULAR has been sent out to the shareholders stating that the scheme for reconstructing the company has the support of an overwhelming majority of each class of the shareholders. The adverse majority is about 2 per cent. in the case of each the ordinary and preference classes. A special general meeting of the ordinary shareholders is to be held on May 31st, at 3 p.m., at Westminster Palace Hotel, to pass the following resolution:—

That the agreement, dated May 17th, 1904, and made between the company of the one part and George Kitchin, on behalf of himself and all others, the holders of ordinary shares in the capital of the company of the other part, submitted to this meeting be, and the same is hereby approved of, sanctioned and confirmed.

The agreement is entered into for the purpose of modifying the rights and privileges attached to the ordinary shares.

At 2.30 p.m. on the same day the preference shareholders are to meet at the same place to approve the following resolution:—

That the agreement, dated May 17th, 1904, and made between the company of the one part and Charles Frederick Howell, on behalf of himself and all others, the holders of preference shares in the capital of the company of the other part, submitted to this meeting be, and the same is hereby approved of, sanctioned and confirmed.

An extraordinary general meeting of the company will follow at 3.30 o'clock to consider the following special resolutions:—

1. That the share capital of the company, at present amounting to £320,000, divided into 140,000 preference shares of £1 each, and 180,000 ordinary shares of £1 each, be reduced to £90,000, divided into 90,000 ordinary shares of £1 each, and that such reduction be effected by cancelling 260 preference shares numbered 9,741 to 10,000 inclusive, which have been duly forfeited and never re-issued by the company, and by writing off capital which has been lost or is unrepresented by available assets to the extent of £229,740 in manner following, that is to say:—
   (*a*) By cancelling 69,740 fully paid preference shares of £1 each.
   (*b*) By cancelling 160,000 fully paid ordinary shares of £1 each.
2. That accordingly upon this scheme being confirmed by the court each holder of preference shares in the present capital shall surrender one-half of his holding to the company for cancellation, and shall retain the other half as ordinary shares in the reduced capital of the company, and each holder of ordinary shares in the present capital shall surrender eight-ninths of his holding to the company for cancellation, and shall retain the remaining one-ninth as ordinary shares in the reduced capital of the company.
3. That in the event of this scheme being confirmed by the court, none of the shares in the reduced capital of the company shall have any right to priority in the return of capital upon a winding up or otherwise, but all the said shares shall rank *pari passu* in all respects, and in the case of profits as from September 30th, 1903, being the close of the last financial year of the company.

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**West Ham Corporation.**—This municipal authority is in the market for a big loan. The amount asked for is £500,000 at 3 per cent., and the price is 84. The stock is redeemable at par on April 1st, 1945, or earlier. The Corporation is in need of money for its electric tramway and lighting undertakings, and for the repayment of temporary loans, which the extension of these and some other works has necessitated. It will be interesting to note what sort of reception is accorded to this issue by the investing public. The rate of interest on the purchase price is a shade over 3½ per cent., and, after 41 years, repayment at par means an additional £80,000 on the £420,000 which the Corporation will now receive—that is, on the somewhat large assumption that the issue is successful.

Should this issue be well subscribed, we may expect that, following immediately on the Croydon municipal application, there will shortly be a shoal of municipal loans floating into London from the numerous needy parts of the provinces on account of electrical and other works. We should be sorry to see them tumbling over one another in their haste. It would spoil all of their chances.

**Barcelona Tramways Co.**—The report for 1903 states that the traffic receipts have amounted to £120,085, and sundry receipts to £56, together £120,141. Working expenses absorbed £83 048, leaving £37,093. From this must be deducted loss on exchange £10,473, and, after adding £2,572, net amount received from the Ensanche Co., and £2,558 brought forward, there remains a balance of £31,750. The directors have placed a further sum of £2,000 to the reserve fund, and they now recommend a dividend on the ordinary shares of 3 per cent. (6s. per share), leaving £1,501 to be carried forward. The further expenditure on capital account in connection with the adoption of electric traction is £13,913. The first application of the sinking fund of the 4½ per cent. redeemable debenture stock was made in February, 1903, when £4,158 of stock was purchased and cancelled at a cost of £4,000. The Ensanche Co.'s system is now being worked—under lease—by this company, and a net sum of £2,572 was received for the year 1903.

**Stock Exchange Notices.**—Applications have been made to the Committee to allow the following securities to be quoted in the Official List:—British Westinghouse Electric and Manufacturing Co., Ltd.—Further issue of £116,363 4 per cent. mortgage debenture stock (redeemable). Edmundson's Electricity Corporation, Ltd.—Further issue of 6 per cent. cumulative preference shares of £5 each, fully paid. They have ordered the undermentioned securities to be quoted in the Official List:—Bromley (Kent) Electric Light and Power Co., Ltd.—14,000 shares of £5 each, fully paid, Nos. 1 to 14,000. London Electric Supply Corporation, Ltd.—Further issue of £121,895 4 per cent. first mortgage debenture stock (redeemable).

**Underground Electric Railways Co. of London.**—The London and Westminster Bank, Ltd., will be prepared to deliver, on and after June 1st next, the definitive engraved notes in exchange for the provisional certificates.

**West African Telegraph Co.**—The directors have declared a dividend of 6s. per share.

## STOCKS AND SHARES.

Wednesday Evening.

As though to underline the fact that the Stock Exchange has hardly recovered from its Whitsun holiday, prices are very stolid, and few changes have taken place since last week amongst the electrical descriptions. Business, indeed, throughout the House has shrunk considerably, but there is no need yet to talk about the languor of summer holiday-tide, as some people are doing, and it may be reasonably supposed that plenty more business will spring up before the hot weather comes.

In some respects, it is a curious thing that the public did not accord a more appreciative welcome to the new Ordinary shares issued at £5 10s. by the Anglo-Argentine Tramways Co. Inquiries made in the market go to show that the underwriters have had to take a fairly high proportion of the shares, but since they were well rewarded for their services, and have, in addition, a good investment, they can scarcely grumble. The price is now 5¼—5½, and, speaking of new issues, Urban Debenture keeps steady at 1 discount to par, at which it looks cheap. Some people object to the latter stock, because they say the tangible security is so slight, forgetting that the same kind of criticism was levelled at the Edmundson's Debenture issue when it appeared, whereas now it is almost impossible to buy it at 107 or 108. London United Tramways new Preference are not yet dealt in, the old shares remaining at 11¼ and the Debenture stock at 103. Early next month the company is hoping to start an accelerated service to Uxbridge, and its extensions are being pushed forward as fast as the directors can get the requisite powers. We understand that the new Preference issue has been successfully covered.

Of the other traction issues, Central London Ordinary has dropped a point, but the Preferred stock has risen 3 to 102½, the Deferred keeping about 86½. Apparently no great improvement can be expected until the two Undergrounds are working electrically, when some idea may be gleaned as to the probable effect of competition. Districts at 40 are dullish, and Metropolitans at 96¼ are the fraction down, although this stock is still relatively cheaper than Districts. City and South London Ordinary recovered to 51. Several of prior-charge stocks have hardened a little on the spreading of the investment movement in these more gilt-edged securities.

By a 10s. rise, British Electric Traction Ordinary have been taken to 9⅜, and the Preference are ¼ up at 10½, although the Debenture at 116½ has lost its improvement of a week ago. Potteries are rather more active—or perhaps it would be more truthful to say, they are less inactive—than usual, the Preference shares attracting most attention at about 9½, while the Ordinary are 8½, and the 4½ per cent. Debenture stock 102½. North Metropolitan Trams are 2¼, Metropolitan Electric Trams Deferred $\frac{3}{16}$, and the Preference nearly 1. Auckland Electric 5 per cent. Debenture stock has risen to par.

None of the four changes in the telegraph list are of any importance. West African shares have come into prominence with a rise of 10s. to £6, and Western Telegraphs are ¼ better at 13. Anglo-Americans are unchanged, but Direct United States put on 5s., and are 10½. Eastern Ordinary lost a point of its recent sharp rise, the price now standing at 128½.

National Telephones are quite as featureless as telegraphs, and the solitary change in the telephone division is a firming up of $\frac{1}{16}$ in Oriental Preference, which brings the price up to a shade over a sovereign.

City of London Electric Ordinary are a good market, and at the round 11 have recovered twice over their ¼ fall of last week. Charing Cross and Strand new Ordinary shares are now quoted in the Stock Exchange Official List, and have established themselves at 6¾, which is 15s. beneath the value of the senior issue. The firmer tone developed by Electrical Supply varieties during May is well maintained; but there is not much trade passing.

Amongst the Miscellaneous shares, Reuter's remain at 7, the dividend announcement (making 5 per cent. for the year) producing no effect. Westinghouse Preference have been done as low as $3\frac{9}{16}$, and the Debenture stock is no better than 90. British Aluminium Preference, at 5½, are 10s. better. Babcock & Wilcox found a buyer at $2\frac{15}{16}$ early in the week, the Preference being still about 30s. Willans and Robinson Ordinary and Preference are 3 and 4 respectively.

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**Craigpark Electric Cable Co.**—We understand from this company that one of the statements which appeared in our brief report (p. 799, ELECTRICAL REVIEW, May 13th) of the company's meeting was inaccurate. The statement referred to is, "that there was very little profit on the year's working." If readers will refer to our issue of a week earlier, they will find it stated on page 756 that the net profit for the 15 months had been £4,433. The sales were in advance of the previous year.

# SHARE LIST OF ELECTRICAL COMPANIES.

## TELEGRAPH AND TELEPHONE COMPANIES.

| Present Issue. | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1901. | 1902. | 1903. | Closing Quotations May 18th. | Closing Quotations May 25th. | Business done week ended May 25th, 1904. Highest | Lowest |
|---|---|---|---|---|---|---|---|---|---|
| 67,100 | African Direct Telegraph, 4 % Debs. | 100 | .. | .. | .. | 99 —103 | 99 —103 | .. | .. |
| 25,000 | Amazon Telegraph Co.'s shares, Nos. 1 to 25,000 | 10 | .. | .. | .. | 2⅛ — 3⅛ | 2⅛ — 3⅛ | .. | .. |
| 119,700£ | Do. do. 5 % Debs., Nos. 1 to 1,250 Red. | 100 | .. | .. | .. | .. — .. | 70 — 80 | .. | .. |
| 788,840 | Anglo-American Telegraph | Stock | 61s. | 60/6 | 61s. | 49 — 52 | 49 — 52 | .. | .. |
| 3,105,680 | Do. do. do. 6 % Pref. | Stock | 6 % | 6 % | 6 % | 94 — 96 | 94 — 96 | 95⅛ | 94⅛ |
| 3,105,680 | Do. do. do. Deferred | Stock | 2s. | 1/- | 2s. | 7⅛ — 7⅜ | 7⅛ — 7⅜ | 7 7/16 | .. |
| 44,000 | Chili Telephone, Nos. 1 to 44,000 | 5 | 5 % | 6 % | .. | 4⅛ — 5⅛ | 4⅛ — 5⅛ | 5 1/16 | 5 |
| 13,388,800$ | Commercial Cable | $100 | 8 % | 8 % | .. | 175 —185 | 175 —185 | .. | .. |
| 1,841,209 | Do. do. Sterling 500 year 4 % Deb. Stock Red. | Stock | .. | .. | .. | 94 — 96 | 94 — 96 | 96 | .. |
| 16,000 | Cuba Telegraph | 10 | 4 % | 6⅛ % | 5 % | 7 — 8 xd | 7 — 8 | .. | .. |
| 6,000 | Do. 10 % Pref. | 10 | .. | .. | .. | 15 — 16 xd | 15 — 16 | .. | .. |
| 12,981 | Direct Spanish Telegraph | .. | .. | .. | .. | .. — .. | .. — .. | .. | .. |
| 6,000 | Do. do. 10 % Cum. Pref. | 5 | .. | .. | .. | 7 — 8 | 7 — 8 | .. | .. |
| 80,000 | Do. do. 4½ % Debs. | 50 | .. | .. | .. | 99 —102 | 99 —102 | .. | .. |
| 60,710£ | Direct United States Cable | 20 | 3½% | 3½% | .. | 10 — 10½ | 10⅛ — 10⅞ | 10⅞ | .. |
| 85,800 | Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red. | 100 | .. | .. | .. | 99 —102 | 99 —102 | .. | .. |
| 4,000,000 | Eastern Telegraph, Ord. Stock | Stock | 7 % | 7 % | .. | 127 —132 | 126 —131 | 131 | 128 |
| 1,955,565 | Do. 3½ % Pref. Stock | 100 | .. | .. | .. | 86 — 89 | 86 — 89 | 88 | .. |
| 1,534,545 | Do. 4 % Mort. Deb. Stock Red. | Stock | .. | .. | .. | 104 —107 | 104 —107 | 106 | 105½ |
| 300,000 | Eastern Extension, Australasia, and China Telegraph | 10 | 7 % | 7 % | 7 % | 11⅞ — 12⅛ | 11⅞ — 12⅛ | 12⅛ | 11⅞ |
| 820,000£ | Do. 4 % Deb. Stock | Stock | .. | .. | .. | 104 —107 | 104 —107 | .. | .. |
| 300,000 | Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909 | 100 | .. | .. | .. | 99 —102 | 99 —102 | .. | .. |
| 200,000£ | Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 3,000 | 25 | .. | .. | .. | 99 —102 | 99 —102 | .. | .. |
| 180,237 | Globe Telegraph and Trust | 10 | 5½% | £3 16 7* | 5½% | 9 — 9½ | 9 — 9½ | 9 7/8 | 9 |
| 180,049 | Do. do. 6 % Pref. | 10 | .. | .. | .. | 13— 13½ | 13 — 13½ | 13⅜ | 13 1/16 |
| 150,000 | Great Northern Telegraph, of Copenhagen | 10 | 15 % | 12½% | 15 % | 25 — 26 | 25 — 26 | 25½ | 25½ |
| 68,700 | Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red. | 100 | .. | .. | .. | 99 —102 | 99 —102 | .. | .. |
| 17,000 | Indo-European Telegraph | 25 | 10 % | 10% | 10 % | 42 — 45 | 42 — 45 | 45 | 44⅓ |
| 1,988,888 | National Telephone, Pref. Stock | 100 | 5 % | 6 % | 6 % | 104 —106 | 104 —106 | 105½ | 104 |
| 1,966,667 | Do. do. Def. Stock | 100 | .. | 4½% | 5 % | 87 — 90 | 87 — 90 | 87 | .. |
| 15,000 | Do. do. 6 % Cum. 1st Pref. | 10 | 6 % | 6 % | 6 % | 11 — 13 | 11 — 13 | .. | .. |
| 15,000 | Do. do. 6 % Cum. 2nd Pref. | 10 | 6 % | 6 % | 6 % | 11 — 13 | 11 — 13 | .. | .. |
| 2,250,000 | Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000 | 5 | 5 % | 5 % | 5 % | 5 — 5½ | 5 — 5½ | 5 3/16 | 5 3/32 |
| 000,000£ | Do. do. 3½ % Deb. Stock Red. | Stock | 3½% | 3½% | 3½% | 98 — 100 | 98 — 100 | 98½ | .. |
| 689,593 | Do. do. 4 % Deb. Stock Red. | 100 | 4 % | 4 % | 4 % | 103 —105 | 103 —105 | 104 | 103½ |
| 1,000,000 | Do. do. Prov. Certs., 70 % to be paid | .. | .. | .. | .. | 29 — 31 | 30 — 32 | 30⅜ | 30½ |
| 179,313 | Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid | 1 | 6 % | 6 % | 6½% | 1 3/32 — 1 1/16 | 1 3/32 — 1 1/16 | .. | .. |
| 50,000 | Do. do. do. 6 % Cum. Pref. | 1 | .. | .. | .. | 1 3/32 — 1 1/16 | 1 — 1 1/16 | .. | .. |
| 100,000£ | Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 | 100 | .. | .. | .. | 97 —100 | 97 —100 | .. | .. |
| 11,889 | Reuter's | 8 | 5 % | .. | .. | 6½ — 7⅓ | 6½ — 7⅓ | .. | .. |
| 8,808 | Submarine Cables Trust | Cert. | .. | .. | .. | 117 —122 | 117 —122 | .. | .. |
| 68,000 | United River Plate Telephone | 5 | 7 % | 7 % | .. | 5⅞ — 6 | 5⅞ — 6 | .. | .. |
| 40,000 | Do. do. 5 % Cum. Pref., Nos. 1 to 40,000 | 5 | .. | .. | .. | 4⅞ — 5⅛ | 4⅞ — 5⅛ | .. | .. |
| 179,947£ | Do. do. 5 % Debs. | Stock | .. | .. | .. | 103 —106 | 103 —106 | .. | .. |
| 15,609 | West African Telegraph, Shares | 10 | .. | 2 % | 4 % | 5 — 6 | 5⅛ — 6⅜ | .. | .. |
| 150,000£ | West Coast of America, 4% Debs., 1 to 1,500 guar. by Bras. Sub. Tel. | 100 | .. | .. | .. | 97 — 100 | 97 — 100 | .. | .. |
| 207,920 | Western Telegraph, Ltd., Nos. 1 to 207,920 | 10 | 7 % | 7 % | 7 % | 12⅜ — 13 | 12⅜ — 13⅛ | 13⅛ | 12⅝ |
| 75,000£ | Do. do. 5 % Debs. 2nd series, 1906 | 100 | .. | .. | .. | 101 —104 | 101 —104 | .. | .. |
| 400,000 | Do. do. 4 % Deb. Stock Red. | 100 | .. | .. | .. | 100 —103 | 100 —103 | .. | .. |
| 88,321 | West India and Panama Telegraph | 10 | .. | .. | .. | ⅜ — ½ | ⅜ — ½ | ⅝ | .. |
| 94,563 | Do. do. do. 6 % Cum. 1st Pref. | 10 | .. | .. | .. | 6 — 6½ | 6 — 6½ | 6 1/16 | .. |
| 4,669 | Do. do. do. 6 % Cum. 2nd Pref. | 10 | .. | .. | .. | 5 — 6 | 5 — 6 | .. | .. |
| 80,000£ | Do. do. do. 5 % Debs., Nos. 1 to 1,800 | 100 | .. | .. | .. | 100 —103 | 100 —103 | .. | .. |

## ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 20,000 | British Aluminium 7 % Cum. Pref. | 10 | .. | .. | .. | 4½ — 5½ | 5 — 6 | .. | .. |
| 800,000£ | Do. do. 5 % 1st Mort. Deb. Stock Red. | Stock | .. | .. | .. | 90 — 95 | 90 — 95 | .. | .. |
| 100,000 | British Electric Traction | 10 | 9 % | 8 % | .. | 9 — 9½ | 9⅝ — 10 | 10 | 9⅝ |
| 100,000 | Do. do. 6 % Cum. Pref. | 10 | .. | .. | .. | 10 — 10½ | 10¼ — 10⅝ | 10 7/8 | 9⅝ |
| 600,000£ | Do. do. 5 % Perpetual Debenture Stock | Stock | .. | .. | .. | 116 —119 | 115 —118 | 117⅝ | 116⅝ |
| 100,000 | British Insulated and Helsby Cables | 5 | 10 % | 10 % | 8 % | 5⅛ — 5⅜ | 5⅛ — 5⅜ | 5⅜ | .. |
| 100,000 | Do. do. 6 % Cum. Pref. | 5 | .. | .. | .. | 5⅛ — 5⅜ | 5⅛ — 5⅜ | .. | .. |
| 50,000 | Do. do. 4½ % 1st Mort. Deb. Red. | 100 | .. | .. | .. | 102 —106 | 102 —106 | .. | .. |
| 50,000 | ¶Browett, Lindley & Co., Ord. | £1 | Nil | .. | .. | 9/16 — 11/16 | 9/16 — 11/16 | .. | .. |
| 50,000 | ¶ Do. do. 6 % Cum. Pref. | £1 | 6 % | .. | .. | 14/6 to 15/6 | 14/6 to 15/6 | .. | .. |
| 105,781 | Brush Electrical Engineering, Ord., 1 to 105,781 | 2 | Nil | Nil | Nil | ½ — 1 | ½ — 1 | .. | .. |
| 150,000 | Do. do. Non-cum. 6 % Pref. | 2 | 3 % | 6 % | 6 % | 1 — 1⅛ xd | 1 — 1⅛ | .. | .. |
| 125,000£ | Do. do. 4½ % Perp. Deb. Stock | Stock | .. | .. | .. | 96 — 99 | 96 — 99 | .. | .. |
| 125,000£ | Do. do. 4½ % Perp. 2nd Deb. Stock | Stock | .. | .. | .. | 73 — 78 | 73 — 78 | .. | .. |
| 85,000 | Callender's Cable Construction shares | 5 | 20 % | 15 % | 12½% | 10½ — 11½ | 10½ — 11½ | .. | .. |
| 40,000 | Do. do. do. 5 % Cum. Pref. | 5 | .. | .. | .. | 5½ — 5¾ | 5½ — 5¾ | .. | .. |
| 90,000£ | Do. do. do. 4½ % 1st Mort. Deb. Stock Red. | Stock | .. | .. | .. | 104 —108 | 104 —108 | .. | .. |
| 1,880,014 | Central London Railway, Ord. Stock | Stock | 4 % | 4 % | 4 % | 92 — 95 | 91 — 94 | 93⅞ | 91½ |
| 494,998 | Do. do. 4 % Pref. Stock | Stock | 4 % | 4 % | 4 % | 98 —101 | 101 —104 | .. | .. |
| 494,998 | Do. do. Def. do. | Stock | 4 % | 4 % | 4 % | 85 — 88 | 85 — 88 | .. | .. |
| 1,980,000 | City and South London Railway | Stock | 2 % | 3½% | 2⅔% | 49 — 51 | 50 — 52 | 51½ | 51⅜ |
| 85,000 | Crompton & Co., Nos. 1 to 85,000 | 8 | 7½% | 5 % | .. | 1⅞ — 2⅛ | 1⅞ — 2⅛ | .. | .. |
| 100,000£ | Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red. | .. | .. | .. | .. | 96 — 99 | 96 — 99 | .. | .. |
| 99,261 | Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261 | ¶ 5 | Nil | Nil | .. | ⅛ — ⅜ | ⅛ — ⅜ | .. | .. |
| 17,139 | Do. do. "A" shares, 01—017,139 | ¶ 5 | Nil | Nil | .. | ⅛ — 1⅛ | ⅛ — 1⅛ | .. | .. |
| 44,023£ | Do. do. 4 % Deb. Stock Red. | £100 | .. | .. | .. | 72 — 77 | 72 — 77 | .. | .. |
| 100,000£ | Do. do. 5 % 2n Deb. Stock Prov. Certs. all pd. | 100 | .. | .. | .. | 74 — 79 | 74 — 79 | .. | .. |
| 112,100 | Electric Construction, 1 to 112,100 | 2 | 6 % | 6 % | .. | 1⅜ — 1⅝ | 1⅜ — 1⅝ | .. | .. |
| 81,390 | Do. do. 7 % Cum. Pref., 1 to 81,390 | 2 | .. | .. | .. | 2⅛ — 2⅜ | 2⅛ — 2⅜ | .. | .. |
| 82,500£ | Do. do. 4½ % Perp. 1st Mort. Deb. Stock | Stock | .. | .. | .. | 97 —100 | 97 —100 | .. | .. |
| 25,000 | General Electric Co. (1900), 5 % Cum. Pref. | 10 | 5 % | 5 % | .. | 9⅛ — 9⅜ | 9⅛ — 9⅜ | .. | .. |
| 800,000 | Do. do. 4 % Mort. Deb. | Stock | .. | .. | .. | 93 — 98 | 93 — 98 | .. | .. |
| 200,000 | Henley's (W. T.) Telegraph Works, Ord. | ¶ 5 | 20 % | 20 % | 15 % | 11⅛ — 12⅛ | 11⅛ — 12⅛ | 11⅜ | .. |
| 200,000 | Do. do. 6½ % Pref. | ¶ 5 | .. | .. | .. | 5 — 5½ | 5 — 5½ | .. | .. |
| 46,900 | Do. do. 4½ Mort. Deb. Stock | Stock | .. | .. | .. | 107 —111 | 107 —111 | .. | .. |
| 50,000 | India-Rubber, Gutta-Percha & Telegraph Works | 10 | 10 % | 10 % | .. | 18⅛ — 19⅛ | 18⅛ — 19⅛ | 19⅛ | .. |
| 800,000£ | Do. do. do. 4 % 1st Mort. Deb. | 100 | .. | .. | .. | 99 —102 | 99 —102 | .. | .. |
| 87,500 | †Liverpool Overhead Railway, Ord. | 10 | 1¼% | 1¼% | .. | 3⅜ — 4 | 4⅛ — 4⅜ | .. | .. |
| 10,000 | † Do. do. Pref. £10 paid | 10 | .. | .. | .. | 10 — 10½ | 10 — 10½ | .. | .. |
| 87,350 | Telegraph Construction and Maintenance | 12 | 20 % | 20 % | 20 % | 35 — 38 | 35 — 38 | 38 | .. |
| 150,000£ | Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909 | 100 | .. | .. | .. | 101 —104 | 101 —104 | 101½ | .. |
| 540,000£ | Waterloo & City Railway, Ord. Stock | 100 | 3 % | 3½% | 3½% | 90 — 93 | 90 — 93 | .. | .. |

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (April 21st, 1904).

## SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

| Present issue. | NAME. | Stock or Share. | Dividends for the last three years 1901. | 1902. | 1903. | Closing Quotations May 18th. | Closing Quotations May 25th. | Business done week ended May 25th, 1904. Highest. | Lowest. |
|---|---|---|---|---|---|---|---|---|---|
| | | † | | | | | | | |
| 100,000 | Blackheath and Greenwich Dist. Electric Light, Ord... .. .. | 1 | .. | .. | .. | ⅝— ¾ | ⅝— ¾ | .. | .. |
| 50,000 | Do. 7 % Pref. .. .. .. .. .. | 1 | .. | .. | .. | 1 — 1¼ | 1 — 1¼ | .. | .. |
| 100,000 | Do. 4½% 1st Deb. Stock, Prov. Certs. .. | 100 | .. | .. | .. | 120 —125 | 120 —125 | .. | .. |
| 20,000 | Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 .. | 5 | 8 % | 8 % | 10 % | 10⅞— 11¼ | 10⅞— 11¼ | 10¼ | .. |
| 20,000 | Do. do. 7 % Cum. Pref. .. | 5 | .. | .. | .. | 10¼— 10⅝ | 10¼— 10⅝ | .. | .. |
| 250,000 | Central Electric Supply 4 % Guar. Deb. Stock .. .. .. | 100 | .. | .. | .. | 107 —110 | 107 —110 | .. | .. |
| 50,000 | Charing Cross and Strand Electricity Supply .. .. .. | 5 | 10 % | 10 % | 8 % | 7¼— 7⅝ | 7¼— 7⅝ | 7⅝ | .. |
| 70,000 | Do. do. do. 4½% Cum. Pref. .. | 5 | .. | .. | .. | 5 — 5¼ | 5 — 5¼ | .. | .. |
| 40,000 | Do. do. "City Undertaking" 4½% Cum. Pref. | 5 | .. | .. | .. | 4⅜— 5 | 4⅜— 5 | .. | .. |
| 40,000 | Do. do. 1903 .. .. .. .. .. | 5 | .. | .. | .. | 4⅜— 5 | 4⅜— 5 | 4⅜ | .. |
| 250,000 | Do. do. 4 % Deb. Stock Red. .. .. .. | 100 | .. | .. | .. | 103 —105 | 103 —105 | 104 | .. |
| 44,486 | *Chelsea Electricity Supply, Ord. .. .. .. .. | 5 | 4 % | 4½% | 5½% | 6¼— 6⅝ | 6¼— 6⅝ | .. | .. |
| 150,000‡ | Do. do. % Deb. Stock Red. .. .. .. | Stock | .. | .. | .. | 107 —110 | 107 —110 | .. | .. |
| 70,595 | City of London Electric Lighting, Ord. 40,001—110,595 .. | 10 | 5 % | 5 % | 5 % | 10½— 10¾ | 10⅝— 11⅛ | 11⅛ | 10⅛ |
| 40,000 | Do. 6 % Cum. Pref., 1 to 40,000 .. .. .. | 10 | .. | .. | .. | 13 — 14 | 13 — 14 | .. | .. |
| 400,000‡ | Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid .. .. | .. | .. | .. | .. | 121 —126 | 121 —126 | .. | .. |
| 300,000 | Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid .. .. | 100 | .. | .. | .. | 101 —104 | 101 —104 | .. | .. |
| 40,000 | County of London & Brush Prov. Electric Lighting, Ord. 1—40,000.. | 10 | 4 % | 4 % | 4 % | 7½— 8½ | 7½— 8½ | .. | .. |
| 20,000 | Do. do. do. 6 % Pref., 40,001—60,000.. | 10 | .. | .. | .. | 11 — 12 | 11 — 12 | .. | .. |
| 400,000‡ | Do. do. 4½% Deb. Stock .. .. .. .. | .. | .. | .. | .. | 106 —109 | 106 —109 | 108 | .. |
| 250,000 | Do. do. 4½% 2nd Deb. Stock .. .. .. .. | Stock | .. | .. | .. | 99 —102 | 99 —102 | 101 | .. |
| 50,000 | Edmundson's Electric Corporation, Ord. Shares .. .. .. | 5 | 7 % | 7 % | .. | 5⅝— 6¼ | 5⅝— 6¼ | .. | .. |
| 80,000 | Do. do. 6 % Cum. Pref. .. .. .. | .. | .. | .. | .. | 5⅝— 6¼ | 5⅝— 6 | .. | .. |
| 140,000 | Do. do. 4½% 1st Mort. Deb. Stock .. | 100 | .. | .. | .. | 105 —108 | 105 —108 | 107½ | 106½ |
| 21,000 | Kensington and Knightsbridge Electric Ord. .. .. .. | 5 | 10 % | 10 % | 12½ | 11¼— 12½ | 11¼— 12½ | .. | .. |
| 90,000 | Do. do. do. 4 % Debenture Stock .. | Stock | .. | .. | .. | 102 —105 | 102 —105 | .. | .. |
| 110,000 | London Electric Supply Corporation, Limited, Ord. .. .. .. | 3 | .. | .. | .. | 1¼— 1⅜ | 1¼— 1⅜ | .. | .. |
| 49,840 | Do. do. do. 6 % Pref. .. .. .. | 5 | .. | .. | .. | 4¼— 5 | 4¼— 5 | 4⅜ | .. |
| 250,000‡ | Do. do. do. 4 % 1st Mort. Deb. Stock Red | Stock | .. | .. | .. | 95 — 98 | 95 — 98 | .. | .. |
| 100,000 | Metropolitan Electric Supply, 1 to 100,000 .. .. .. .. .. | 10 | 6½% | 7½% | 8½% | 19⅜— 20¼ | 19⅛— 20¼ | 19⅜ | 19⅛ |
| 71,106 | Do. do. 4½% Cum. Pref. 1—71,106, £3 paid .. | 5 | .. | .. | .. | 5⅜— 5⅝ | 5⅜— 5⅝ | 5⅝ | 5½ |
| 220,000‡ | Do. do. 4½% 1st Mort. Deb. Stock .. .. | .. | .. | .. | .. | 109 —113 | 109 —113 | .. | .. |
| 250,000‡ | Do. do. 3½% Mort. Deb. Stock Red .. .. | Stock | .. | .. | .. | 97 —100 | 97 —100 | .. | .. |
| 10,852 | Notting Hill Electric Lighting .. .. .. .. | 10 | 6 % | 6 % | 6 % | 12½— 13½ | 12½— 13½ | .. | .. |
| 40,000 | St. James' and Pall Mall Electric Light, Ord. .. .. .. | 5 | 14½% | 14½% | 14½% | 14 — 15 | 14 — 15 | 14½ | .. |
| 20,000 | Do. do. do. 7 % Pref. 20,081 to 40,080 | 5 | .. | .. | .. | 8 — 9 | 8 — 9 | 8⅛ | 8⅛ |
| 150,000‡ | Do. do. do. 3½% Deb. Stock Red .. | 100 | .. | .. | .. | 97 —100 | 97 —100 | .. | .. |
| 12,008 | Smithfield Markets Electric Supply, Ord. .. .. .. | 5 | .. | 2½% | 4 % | 3 — 3½ | 3 — 3½ | .. | .. |
| 50,000 | Do. do. 4 % Deb. Stock .. .. | Stock | .. | .. | .. | 85 — 90 | 85 — 90 | .. | .. |
| 65,000 | South London Electricity Supply, Ord. .. .. .. .. | 5 | .. | 1½% | 3 % | 3¾— 4¼ | 3¾— 4¼ | .. | .. |
| 80,000 | Urban Electric Supply, Ord. .. .. .. .. | 5 | .. | .. | .. | 4⅜— 4⅝ | 4⅜— 4⅝ | .. | .. |
| 80,000 | Do. do. 5 % Cum. Pref. .. .. .. | 5 | .. | .. | .. | 4⅜— 4⅝ | 4⅜— 4⅝ | .. | .. |
| 110,000 | Westminster Electric Supply, Ord. .. .. .. .. | 5 | 10½% | 12 % | 13½% | 12½— 13⅝ | 12½— 13⅝ | 13⅝ | 12½ |
| 28,141 | Do. do. 5 % Cum. Pref. .. .. .. | 5 | .. | .. | .. | 6¼— 6½ | 6¼— 6½ | .. | .. |

* Subject to Founders Shares. † Unless otherwise stated all shares are fully paid.

## MARKET QUOTATIONS, Wednesday, May 25th.

### CHEMICALS, &c.

| | | Latest Price. | Week's Inc. or Dec. |
|---|---|---|---|
| *a* Acid, Hydrochloric .. .. | per cwt. | 5/- | .. |
| *a* ,, Nitric .. .. .. | per cwt. | 29/- | .. |
| *a* ,, Oxalic .. .. .. | per cwt. | 32/- | .. |
| *a* ,, Sulphuric .. .. | per cwt. | 5/6 | .. |
| *a* Ammoniac, Sal .. .. | per cwt. | 42/- | .. |
| *a* Ammonia, Muriate (crystal) .. | per ton | £38 10 | .. |
| *a* ,, ,, .. .. | per ton | £30 | .. |
| *a* Bleaching powder .. .. | per ton | £4 10 | .. |
| *a* Bisulphide of Carbon .. | per ton | £15 | .. |
| *a* Borax .. .. .. | per ton | £13 | .. |
| *a* Benzole (90 %) .. .. | per gal. | 7/- | .. |
| *a* ,, (50/90 %) .. .. | per gal. | 5/6 | .. |
| *a* Copper Sulphate .. .. | per ton | £21 10 | .. |
| *a* Lead, Nitrate .. .. | per ton | £24 | .. |
| *a* ,, White Sugar .. .. | per ton | £31 | .. |
| *a* ,, Peroxide .. .. | per ton | £27 10 | .. |
| *a* Methylated Spirit .. .. | per gal. | 2/6 | .. |
| *a* Naphtha, Solvent (90% a 160° C). | per gal. | 5/6 | .. |
| *a* Potash, Bichromate, in casks .. | per lb. | 8d. | .. |
| *a* ,, Caustic (75/80%).. | per ton | £24 | .. |
| *a* ,, Bisulphate .. .. | per ton | £35 | .. |
| *a* Shellac .. .. .. | per cwt. | 215/- | .. |
| *a* Sulphate of Magnesia .. | per ton | £4 10 | .. |
| *a* Sulphur, Sublimed Flowers .. | per ton | £6 10 | .. |
| *a* Recovered .. .. | per ton | £5 10 | .. |
| *a* ,, Lump .. .. | per ton | £5 | .. |
| *a* Soda, Caustic (white 70 %) .. | per ton | £10 15 | .. |
| *a* Crystals .. .. | per ton | £8 | .. |
| *c* Bichromate, casks.. .. | per lb. | 2½d. | .. |

### METALS, &c.

| | | Latest Price. | Week's Inc. or Dec. |
|---|---|---|---|
| *b* Aluminium Ingots, in ton lots .. | per ton | £180 | .. |
| *b* ,, Wire, in ton lots .. | per ton | £168 | .. |
| *b* ,, Sheet, in ton lots .. | per ton | £166 | .. |
| *p* Babbitt's metal ingots .. .. | per ton | £43 to £130 | .. |
| *c* Brass (rolled metal 2' to 12') basis | per lb. | 6½d. | ½d. dec. |
| *c* ,, Tube (brazed) .. .. | per lb. | 8½d. | ½d. dec. |
| *c* ,, ,, (solid drawn).. .. | per lb. | 7½d. | ½d. dec. |
| *c* ,, Wire, basis.. .. .. | per lb. | 6½d. | ½d. dec. |
| *c* Copper Tubes (brazed) .. .. | per lb. | 9½d. | ½d. dec. |
| *c* ,, ,, (solid drawn) .. | per lb. | 9½d. | ½d. dec. |
| *g* Copper Bars (best selected .. | per ton | £72 | £2 dec. |

### METALS, &c. (*continued*).

| | | Latest Price. | Week's Inc. or Dec. |
|---|---|---|---|
| *g* Copper Sheet .. .. .. | per ton | £72 | £2 dec. |
| *g* ,, Rod .. .. .. | per ton | £72 | £2 dec. |
| *c* ,, (Electrolytic) Bars .. | per ton | £64 | .. |
| *c* ,, ,, Sheets .. | per ton | £80 | .. |
| *c* ,, ,, Rod .. | per ton | £74 | .. |
| *c* ,, ,, H.C. Wire | per lb. | 8d. | .. |
| *f* Ebonite Rod .. .. .. | per lb. | 3/8 | .. |
| *f* ,, Sheet .. .. .. | per lb. | 3/- | .. |
| *n* German Silver Wire .. .. | per lb. | 1/6 | .. |
| *h* Gutta-percha fine .. .. | per lb. | 8/- | .. |
| *h* India-rubber, Para fine .. .. | per lb. | 4/9½ to 4/10½ | dec. |
| *i* Iron, Charcoal Sheets .. .. | per ton | £18 | .. |
| *i* ,, Pig (Cleveland warrants) | per ton | 44/6 | .. |
| *i* ,, Forgings, according to size | per ton | From £11 | .. |
| *i* ,, Scrap, heavy .. .. | per ton | 47/6 to 50/- | .. |
| *i* ,, Wire, galvanised No. 8 .. | per ton | £9 15 | .. |
| *g* Lead, English Ingot .. .. | per ton | £12 to £12 2 6 | dec. |
| *g* ,, ,, Sheet .. .. | per ton | £18 | .. |
| *m* Manganin Wire No. 28 .. .. | per lb. | 8/- | .. |
| *g* Mercury .. .. .. | per bot. | £8 2 6 | .. |
| *d* Mica (in original cases) small .. | per lb. | 6d. to 1/ | .. |
| *d* ,, ,, ,, medium | per lb. | 2/6 to 4/- | .. |
| *d* ,, ,, ,, large .. | per lb. | 4/6 to 8/6 | .. |
| *p* Phosphor Bronze, plain castings | per lb. | 1/- to 1/2½ | .. |
| *p* ,, rolled bars & rods | per lb. | 1/- to 1/8 | .. |
| *p* ,, ,, strip & sheet | per lb. | From 1/1 | .. |
| *o* Platinum .. .. .. .. | per oz. | £4 | .. |
| *c* Silicium Bronze Wire .. .. | per lb. | 9d. to 11d. | .. |
| *i* Steel, Magnet, acc'd'g to desc'p'n | per ton | £58 | .. |
| *i* ,, ,, in bars .. .. | | £15 to £40 | .. |
| *g* Tin, Block .. .. .. .. | per ton | £126 to £127 | £1 dec. |
| *g* ,, Foil .. .. .. .. | per lb. | 1/6 | .. |
| *n* ,, Wire, Nos. 1 to 16 .. .. | per lb. | 1/7 | .. |
| *p* White Anti-friction Metals— "White Ant" brand .. | per ton | £42 to £62 | .. |
| *j* Yarns, 2/10s Grey Cotton, on sp'ls | per lb. | 8d. | .. |
| *j* ,, 6 lea. Flax .. .. .. | per lb. | 5½d. | .. |
| *j* ,, 3 ply 10 lbs. Russian .. | per lb. | 4½d. | .. |
| *j* ,, 10 lbs. Russian, single .. | per lb. | 4½d. | .. |
| *j* ,, 180 lbs. Jute rove .. | per ton | £11 | .. |
| *k* Zinc, Sh't (Vieille Montagne bnd.) | per ton | £25 5 | .. |

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co., *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

## ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

| | Locality. | Week ending | Receipts for the week. £ | £* | No. wks. | Total to date. £ | £* | Miles open. | * |
|---|---|---|---|---|---|---|---|---|---|
| Elec. Trac. Co. | Aberdeen .. .. | May 14 | 1,177 | +229 | 50 | 60,100 | +12,313 | 10 | — |
| | Birmingham .. | ,, 21 | 5,576 | +343 | 21 | 109,586 | + 6,153 | 3½ | — |
| | Bournemouth .. | ,, 18 | 988 | + 28 | 94 | 82,735 | — | 10½ | — |
| | Blackburn .. .. | ,, 20 | 928 | +182 | 8 | 7,288 | + 550 | 13½ | — |
| | Blackpool .. .. | ,, 19 | 512 | + 68 | 7 | 4,608 | + 479 | 5 | — |
| | ,, —Fleetw'd | ,, 21 | 394 | + 4 | 21 | 5,259 | — 252 | 7½ | — |
| | ,, —Lytham | ,, 12 | 271 | — | 28 | 5,196 | + 4,617 | 7½ | — |
| | Bolton .. .. | ,, 22 | 1,752 | —337 | 8 | 18,618 | — 229 | 25 | — |
| | Bradford .. .. | ,, 14 | 4,055 | +784 | 6 | 27,424 | + 4,911 | 46 | — |
| | Brighton .. .. | ,, 22 | 910 | — 11 | — | 6,566 | — | 7½ | — |
| | Bristol .. .. | ,, 20 | 5,105 | +230 | — | — | — | 28 | — |
| | Devonport .. | ,, 18 | 482 | + 66 | 19 | 8,981 | + 1,247 | 5 | — |
| | Dudley—Sto'rb'ge | ,, 13 | 770 | + 35 | 19 | 14,655 | + 644 | 18½ | — |
| | Gateshead .. | ,, 18 | 836 | + 32 | 19 | 16,497 | + 886 | 10½ | + ½ |
| | Gr'n'k—Pt. Glsgw | ,, 13 | 585 | +14 | 19 | 9,274 | + 674 | 7½ | — |
| | Hartlepool .. | ,, 13 | 259 | + 30 | 19 | 4,827 | + 511 | 6½ | +2 |
| | Oldham—Ashton | ,, 13 | 502 | — 41 | 19 | 9,740 | — 529 | 8 | — |
| | Potteries .. .. | ,, 13 | 1,654 | +108 | 19 | 31,646 | + 2,607 | 28½ | — |
| | Southport .. .. | ,, 13 | 298 | + 30 | 19 | 5,068 | + 362 | 5½ | — |
| | South Staffs. .. | ,, 13 | 741 | — 92 | 19 | 14,461 | — 12 | 21½ | — |
| | Swansea .. .. | ,, 13 | 485 | + 31 | 19 | 9,035 | + 344 | 5½ | — |
| | Wolverhampton.. | ,, 13 | 354 | + 2 | 19 | 6,652 | — 260 | 10½ | +8 |
| | Yorks. Wool Dist. | ,, 13 | 543 | +259 | 19 | 10,387 | + 4,585 | 6 | — |
| | Miscellaneous .. | ,, 13 | 2,826 | — | 19 | 40,158 | — | — | — |
| | Burnley .. .. | ,, 21 | 1,011 | +227 | — | — | — | 10½ | +3½ |
| | Burton-on-Trent .. | ,, 28 | 336 | — | 7 | 2,555 | — | 8½ | — |
| | Cardiff .. .. | ,, 14 | 1,872 | +168 | — | 12,341 | + 599 | 1 | — |
| | Chatham & District | ,, 12 | 587 | + 34 | 19 | 10,057 | + 1,701 | 8·58 | — |
| | Cork .. .. .. | ,, 19 | 488 | — 30 | 20 | 8,199 | — 927 | 9 | — |

* Compared with the corresponding period of 1903.

| | Locality. | Week ending | Receipts for the week. £ | £* | No. wks. | Total to date. £ | £* | Miles open. | * |
|---|---|---|---|---|---|---|---|---|---|
| | Dover .. .. | May 14 | 195 | + 2 | 19 | 3,461 | — 186 | 3 | — |
| | Dublin .. .. | ,, 20 | 4,984 | —180 | 21 | 90,658 | + 2,177 | 47 | + ½ |
| | East Ham .. .. | ,, 21 | 771 | +122 | — | 5,499 | + 712 | 5 | + ½ |
| | Glasgow .. .. | ,, 21 | 14,855 | + 876 | 51 | 696,752 | +60,128 | 70 | +5½ |
| | Halifax (2 weeks) .. | ,, 4 | 2,749 | + 479 | 5 | 6,974 | + 439 | 33 | +2½ |
| | Huddersfield .. | ,, 21 | 1,266 | + 59 | 7 | 9,259 | + 647 | 28 | — |
| | Hull .. .. .. | ,, 21 | 2,035 | +807 | 7 | 15,190 | + 1,164 | 13 | +2½ |
| | Ilkeston .. .. | ,, 18 | 189 | — | — | 8,820 | — | 4 | — |
| | Ipswich .. .. | ,, 21 | 461 | — | 7 | 3,192 | — | 10½ | — |
| | Isle of Thanet .. | ,, 21 | 512 | + 27 | 20 | 6,378 | — 315 | 10½ | — |
| | Leeds .. .. .. | ,, 14 | 5,241 | +398 | — | 39,385 | + 3,215 | 81½ | +2 |
| | Liverpool .. .. | ,, 14 | 9,976 | +160 | 20 | 193,854 | + 4,585 | 108 | — |
| | London C. C. .. | ,, 14 | 10,588 | +1292 | 6 | 68,752 | +18,826 | 82¾ | —7 |
| | Manchester .. .. | ,, 21 | 11,991 | +180 | 7 | 82,050 | + 1,717 | 131½ | — |
| | Newcastle .. .. | ,, 21 | 3,636 | +407 | — | — | — | 17 | — |
| | Portsmouth .. .. | ,, 21 | 1,781 | + 92 | — | 13,426 | + 1,372 | 14½ | — |
| | Salford .. .. | ,, 16 | 3,974 | +923 | — | 25,962 | + 3,582 | 30 | — |
| | Sheffield .. .. | ,, 22 | 4,629 | + 52 | 8 | 37,573 | + 1,007 | 33 | +5½ |
| | Southampton .. | ,, 19 | 958 | + 14 | — | — | — | 9 | — |
| | Southend-on-Sea .. | ,, 18 | 307 | + 39 | 7 | 1,974 | + 170 | 6½ | — |
| | Sunderland .. .. | ,, 22 | 1,260 | + 37 | 7 | 8,761 | + 257 | 20 | +3 |
| | Tyneside .. .. | ,, 18 | 365 | + 55 | 20 | 5,996 | + 204 | 8·9 | + ·4 |
| | West Ham .. .. | ,, 19 | 788 | — | 12 | 6,494 | — | 4·56 | — |
| | Wolverhampton .. | ,, 18 | 600 | +201 | — | — | — | 7·563 | — |
| | Cen. London Rly. .. | ,, 21 | 6,549 | —482 | 21 | 144,987 | — 1,908 | 6 | — |
| | City & S. Lon. Rly. | ,, 22 | 2,656 | —255 | 21 | 63,486 | — 2,348 | 6½ | — |
| | Dublin—Lucan Rly. | ,, 22 | 132 | + 9 | 21 | 2,100 | + 185 | 6½ | — |
| | L'pool Ovarh'd Rly. | ,, 22 | 1,643 | — 6 | 21 | 32,806 | + 138 | 6½ | — |
| | Mersey Railway .. | ,, 14 | 1,491 | +117 | 19 | 27,996 | + 6,449 | 4½ | — |

## INSTITUTION OF ELECTRICAL ENGINEERS.

### POWER STATION DESIGN.

By C. H. Merz, Member, and Wm. McLellan, Associate Member.

*(Paper read in London, April 28th, 1904.)*

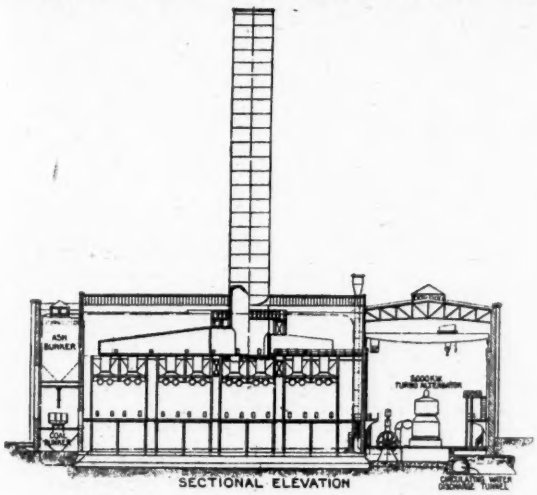
*(Continued from page 849.)*

For a comparatively large power station of, say, an initial capacity of 10,000 kw., capable of extension to three or four times this size, and especially for one utilising steam turbines, the general arrangement shown by figs. 6 and 7 is convenient, as it fulfils the several requirements we have laid down, namely, (1) simplicity of design; (2) sub-division of plant; (3) saving of labour; (4) ease of extension.

A turbine occupies so little floor space in comparison with its output that it is impossible to adopt what had almost become a standard arrangement, *i.e.*, having one or two lines of boilers parallel with the engine room, as by so doing sufficient boiler house capacity could not be obtained without wasting an excessive amount of floor space in the engine room through spacing the turbines very far apart. In fact, with turbines there are only two alternatives possible, either to have a two-storey boiler house or to arrange groups of boilers at right angles to the axis of the engine room, providing each turbine with its own group of boilers.*

The designs shown in figs. 7, 8, and 9, are typical of the three possible arrangements so far as the relative positions of engines and boilers are concerned. Fig. 8 may be considered most suitable for power stations up to 5,000 kw. The arrangement shown in fig. 9 with the double row of boilers has been extensively adopted both in this and other countries. It has, however, many objections—it is difficult to allow for unlimited extension, and the steam and feed piping are considerably longer than in other arrangements. For all power stations of over 5,000 kw. capacity, especially stations for power supply (which must be designed for large extensions) the authors consider the arrangement shown by figs. 5, 6, and 7, the best and most flexible. It may be specially noted how this design facilitates an alteration in the size of units without upsetting the general arrangement of the station, as the extension boiler houses may be longer.

The arrangement of the auxiliary plant (including in this term all piping and cable connections) is a most important factor in the design of the engine room. A design which probably originated on the Continent, and which is carried out there extensively, has also been largely adopted in this country, *i.e.*, the provision of a basement to contain all pipes and auxiliary machinery. Experience has shown this to be an extravagant method, affecting adversely both capital and running costs. It is, in short, directly antagonistic to



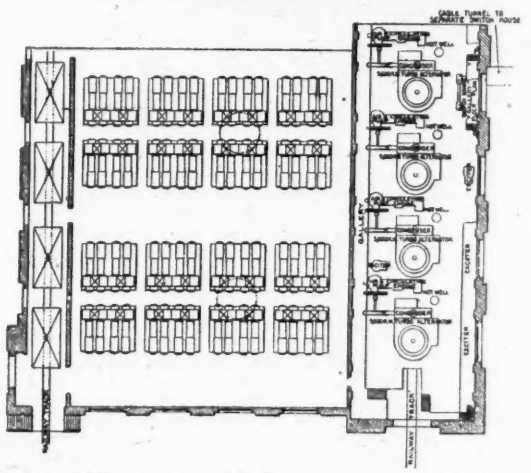



Fig. 5a.—General Arrangement showing Four Complete Units, Fisk Street Power Station, Chicago.

* A similar arrangement has been adopted by Messrs. Sargent and Lundy for the new stations at Boston and Chicago (see fig. 5), where Curtis turbines are being installed. The authors have independently adopted it at Carville, where Parsons turbines are in use. (See figs. 6 and 7.)

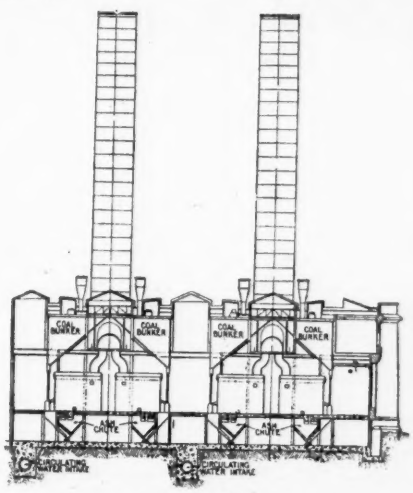



Fig. 5b.—Section through Boiler House, Fisk Street Station.

Fig. 6.

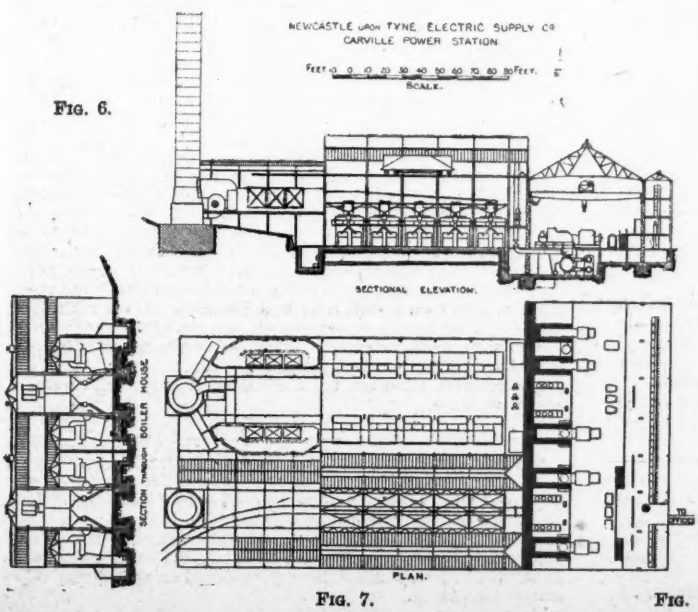



Fig. 7.

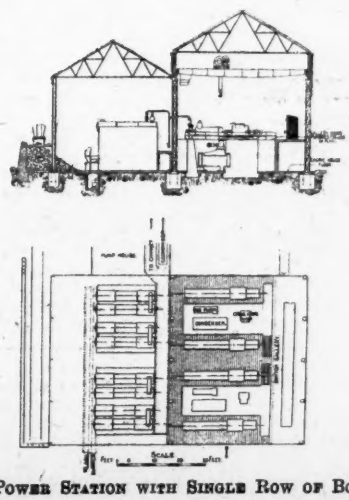


Fig. 8.—Power Station with Single Row of Boilers.

the requirements which we have laid down as essential to an efficient design. It is also expensive in running wages, as unless the plant be allowed to run with practically no attention, more men are required, and it is expensive in repairs on account of the difficulty of providing lifting tackle and the necessity of working entirely with localised artificial light. Against these objections the only advantage is a clean engine room floor. Various arrangements have been adopted by engineers to avoid the inherent defect of installing the auxiliary apparatus in the basement. The provision of wells or pits instead of a basement in the main engine room has been frequently adopted, and though this arrangement hardly gets over the difficulty with regard to piping, it certainly reduces the supervision and attention required.

The turbine, on account of the small floor space which it occupies, has simplified matters immensely, as with it all apparatus can easily be put on the one floor, or (as is desirable on account of increased efficiency) the condenser may be placed directly *below* the turbine;* in the latter case the turbine, as it requires little or no attention, can be left to run by itself at a higher level with merely a gallery round it. The auxiliary apparatus, requiring as it does much more attention, can then be put on what may be regarded as the main floor. Both arrangements allow of all apparatus being conveniently handled by the main crane—though neither provides that perfect-looking engine room which is a feature of many Continental stations.

### 3.—Spare Plant and the Rating of Plant.

The whole question of spare plant and its proportion to the output of the station is an important one in design—as also is that of securing the correct relative capacity of the various pieces of

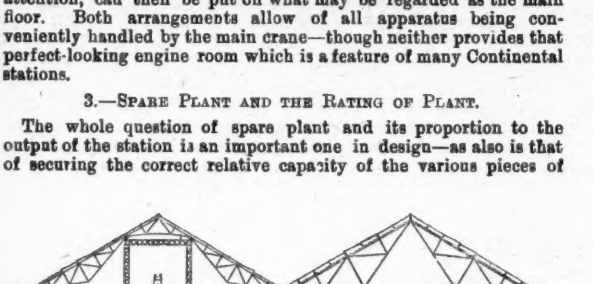



Fig. 9.—Station with Double Row of Boilers.

apparatus making up a complete unit: the boiler, the engine, the generator, and the switchgear. On the one hand, if the various components in the station which make up a complete unit have different degrees of reliability, or if some require more overhauling and inspection than others, then obviously different margins of spare plant are required. Again, while every piece of apparatus may be said to have one point at which it works at maximum economy, overload capacity is generally obtainable at small expense, though possibly by some sacrifice of running economy.

We suggest that a very great saving can be made in the total cost of production (through a reduction of capital charges)† if proper attention be paid to these points, as follows:—

1. By correctly apportioning the spare plant for each piece of apparatus making up a complete unit.
2. By correctly apportioning the overload capacity of each piece of apparatus making up a complete unit.
3. By designing the plant so that the economical rating of each component is identical.
4. By not only relying upon the overload capacity for dealing with sudden emergencies (say a shut-down of one of the units that may happen to be running at the time), but also depending upon it for the ordinary peak load of the station, or when other plant is being overhauled.

In a gas engine, as the economical rating coincides with the maximum rating, both peak and breakdowns can only be met by installing additional plant. In the case of a steam station, if the load under normal (not peak) conditions is equal to the economical rating of one machine only, then it is clear that, while it might be possible to take care of the peak with the overload capacity of that machine, an additional unit is essential to allow for periodical overhaul and to guard against failure through the breakdown of a unit-section.

The three factors to be met by the installation of machines having an overload capacity and by the provision of spare machines are: (1) the peak, (2) periodical overhaul, (3) breakdowns. Whether any or all of these factors are best met by additional plant or by overload capacity depends on the number of units installed, and on the relation between the peak and the overload capacity procurable; but, in any case, it seems to us important to take the overload capacity into consideration in designing a station, and to consider it a feature in design—not merely a casual advantage which may happen to come in useful. We attach 12 typical load curves, one for each month of the year 1903 for the Neptune Bank power station (fig. 10). As a matter of fact, if we take the year in question, and consider the normal load as 100, the peak load is 100 per cent. higher, or 200. The total number of units sent out of the station while the load was at or below normal (100) was more than 80 per cent. of the total number of units sent out during the year. In other words, if this 100 per cent. peak is represented by 100 per cent. extra plant, the 100 per cent. of extra plant only turned out a proportion of the balance of 20 per cent. of the total units.

While, therefore, it is important that the plant should operate economically at normal rating, it is of equal importance that it should have a uniformly high overload capacity. Little regard need be paid to the running costs at the peak, as the resulting fractional increased coal consumption is far more than balanced by the saving in capital charges.* The steam turbine lends itself

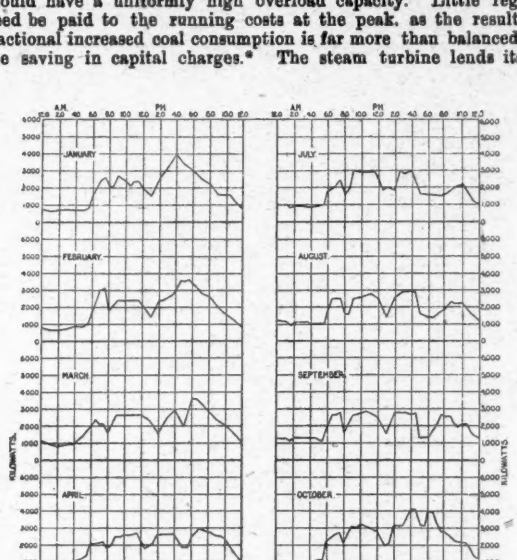



Fig. 10.

admirably to dealing with large overloads, as, by means of a by-pass admitting high pressure steam to the low pressure section of the turbine, the capacity of the turbine can be increased 50 per cent., though this is, of course, accompanied by a certain drop in economy. Standard designs of alternators can be built without excessive cost to stand an overload of 50 per cent. for two hours. If, therefore, the boiler plant has a similar range of elasticity, the peak can be met by simply forcing all plant beyond its economical production point, and by doing the same in the engine room if any of the units are out of commission for overhaul. There is no great difficulty in securing that the boilers shall have the necessary elasticity even under natural draught, but under mechanical draught the solution is easy. In fact, the adoption of artificial draught improves the control of the boiler house plant so enormously under ordinary conditions, that it is, in our opinion, desirable to install it apart altogether from the question of emergency output.

Apart from actual personal experience, it is only by comparing one station with another that an engineer can hope to improve his design, so far as low capital cost is concerned. It is, therefore, important that the basis of comparison should be fair and uniform, but it is not a particularly simple problem to define what this uniform basis should be. It is evident, for instance, that for all practical purposes a station containing, say, four steam turbines, each of a normal economical rating of 2,500 kw., is of larger capacity than a station containing two turbines each of a normal economical rating of 5,000 kw., while these steam stations are respectively of larger capacity than a gas-engine station containing four units of 2,500 kw. normal economical rating, or two units of 5,000 kw. normal economical rating. As can be seen at a glance from the following table, there are eight different ways in which a station may be rated:—

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* The General Electric Co. of America are developing their Curtis turbine with a condenser in the base of the turbine itself, which at once secures this advantage. In the case of small units it is an advantage to provide a condenser for each pair of sets, as in this way at light loads the advantage of a high vacuum is obtained.

† For importance of low capital charges see page 803 and fig. 1.

* It does not follow that even the fuel costs must necessarily be increased by forcing the plant at the peak. In the case of a very short peak, such as is formed by the load of works which shut down at five o'clock overlapping the lighting load, the all-day economy of the boiler house may be actually improved, due to the fewer boilers kept under steam. On account of possible low steam pressure, however, this is only safe with proper induced draught, giving ample margin for forcing.

| | Continuously. | For a short period. |
|---|---|---|
| Maximum possible load ... ... | (1) | (5) |
| Maximum economical load ... ... | (2) | (6) |
| Maximum possible, less allowance for spare plant ... ... ... | (3) | (7) |
| Maximum economical, less allowance for spare plant ... ... ... | (4) | (8) |

(1) On the basis of the maximum *possible* load which the station is capable of dealing with continuously, making no allowance for spare plant.

(2) On the basis of the maximum *economical* load which the station is capable of dealing with continuously, making no allowance for spare plant.

(3) On the basis of the maximum possible load which the station is capable of dealing with continuously, *less an allowance for spare plant.*

(4) On the basis of the maximum economical load which the station is capable of dealing with continuously, *less an allowance for spare plant.*

(5) On the basis of the maximum *possible* load which the station is capable of dealing with for a short period, making no allowance for spare plant.

(6) On the basis of the maximum *economical* load which the station is capable of dealing with for a short period, making no allowance for spare plant.

(7) On the basis of the maximum possible load which the station is capable of dealing with for a short period, *less an allowance for spare plant.*

(8) On the basis of the maximum economical load which the station is capable of dealing with for a short period, *less an allowance for spare plant.*

Of the above No. 4 would seem, at first sight, to be the most reasonable, *i.e.*, rating the station on the basis of the maximum economical continuous output, making due allowance for spare plant. This would certainly be correct if we were dealing with load-factors of 100 per cent., as of course in such cases practically the only value of overload capacity is for dealing with a sudden emergency due to the failure of one of the running units. As, however, we are considering essentially a station for power supply where the load-factor over the year may be expected not to exceed 25 to 30 per cent., low cost of production will be facilitated by the engineer considering capital expenditure rather from the point of view of the most economical way of dealing with the peak load, or, in other words, if in estimating the capital cost he considers that the rating of the station is based on its maximum possible output for one or two hours—that is to say, on the basis of No. 5.

The authors consider that by proper attention to spares and overload capacity the cost per KW. of maximum output of a power station can be reduced from 20 to 40 per cent., depending, of course, on the load factor to be dealt with.

The selection of a suitable size for the generating units is a question which is intimately associated with that of spare plant and capital cost, more particularly where future extensions are taken into account.

That the *number* of units should be kept as low as possible (especially with steam turbines) may be taken as axiomatic; and this, of course, points to units of large size. On the other hand, a limit is set to this reduction in *number* by the following factors:—

(*a*) The amplitude of load variation throughout the 24 hours, or at different seasons of the year.

(*b*) The capital cost of spare plant.

In general, a solution which meets (*b*) will also be consistent with (*a*).

(*To be continued.*)

## THE CONSUMER'S DEPOSIT.

[FROM OUR LEGAL CONTRIBUTOR.]

It not infrequently happens that, before connecting up a consumer's premises after an application form has been sent, an electric supply company insists upon payment of a deposit, whether their prospective consumer is a substantial customer or no. From the company's point of view, no doubt this is a satisfactory arrangement; but the loss of interest on so much capital is sometimes an important matter for the consumer to consider.

Further, the fact that the company can apply the deposit towards payment of arrears of their charges for electricity, takes it out of the power of the consumer to obtain redress for irregularity in supply or other default on the part of the company by stopping payment of his quarterly account.

In these circumstances, it may be of interest to inquire into those parts of the Electric Lighting Acts which enable the company to make this charge. The term "company" includes, for our present purpose, every municipal corporation or other local authority authorised to supply electricity within their district.

It is provided by Sec. 19 of the Electric Lighting Act, 1882, that, where a supply of electricity is provided in any part of an area for private purposes, then, except in so far as is otherwise provided by the terms of the licence, order, or special Act authorising such supply, every company or person within that part of the area shall, on application, be entitled to a supply on the same terms on which any other company or person in such part of the area is entitled, under similar circumstances, to a corresponding supply.

The obligation of the company is also expressed in the Electric Lighting (Clauses) Act, 1899, which provides that the undertakers shall, on being required to do so by the owner or occupier of any premises within 50 yards from any distributing main of the undertakers in which they are, for the time being, required to maintain, or are maintaining, a supply of energy for the purposes of general supply to private consumers, give, and continue to give, a supply of energy for those premises, and shall furnish and lay any electric lines that may be necessary for the purpose of supplying the maximum power to which such owner or occupier is entitled. This is subject to the following conditions:—(1) The consumer must pay (if required) the cost of so much of the electric line as may be laid upon his premises, and of so much of any such electric line as it may be necessary to lay for a greater distance than 60 ft. from the distributing main although not on such premises; (2) The owner or occupier requiring the supply must serve a notice upon the undertakers specifying the premises and the maximum power required, and a reasonable date upon which the supply is required to commence; (3) He must enter into a written contract with the undertakers (if required) to take and pay for a supply for at least three years of such an amount that the payment to be made for the same at the rates being charged to ordinary consumers shall not be less than 20 per cent. on the outlay incurred by the undertakers; and he must also give, if required, security for moneys which may become due. This security may be required even after the undertakers have begun to give a supply of energy; but the undertakers must give seven days' notice. The undertakers are not compellable to give a supply of energy to any premises unless they are reasonably satisfied that the electric lines, fittings, and apparatus therein are in good order and condition, and "not calculated to affect injuriously the use of energy by the undertakers or other persons." Any difference as to any improper use of energy or as to any alleged defect in any electric lines, fittings, or apparatus, is to be determined by arbitration, the arbitrator being appointed by the Board of Trade.

The short effect of the foregoing provisions, is that there must be no undue preference to any consumer, and that the company are entitled to ask for security; but it is not a little difficult to see how the company can simply demand a deposit of every consumer. The proper way to look at the question is to consider what would be the position if a consumer refused to pay the deposit, and summoned the company for refusing to supply him. Section 30 of the Electric Lighting (Clauses) Act, 1899, provides that whenever the undertakers make default in supplying energy to any owner or occupier of premises to whom they may be, and are, required to supply energy under the special order, they shall be liable in respect of each default to a penalty not exceeding 40s. If summoned under this Section, the company would be compelled to bring proof that the deposit demanded by them of the consumer was necessary in order to defray the cost incurred by them in laying the wires to his premises. But even this would not seem, under a strict interpretation of the enactment, to be sufficient, for the company merely have power to require the consumer to enter into a contract with them "to take and pay for a supply for at least three years, &c."; the Act says nothing about demanding a deposit for the ostensible purpose of preventing the company being defrauded by an unscrupulous consumer.

It is possible, however, that a magistrate who heard the summons would consider that the demand of a small deposit was reasonable on the part of the company; but, on the other hand, it has to be remembered that a company supplying electricity is the creature of statute, the wielder of a partial (if we may use the term) monopoly, and that they are vested with many powers for enforcing the payment of meter rent. To sum up, we can only say that we do not see clearly how it is that the companies have power under the ordinary statutes to demand the deposit. It may be, of course, that each company which makes this demand of a deposit has special power to do so under its Act; but this is unlikely, inasmuch as the Electric Lighting (Clauses) Act, 1899, provides a form of provisional order designed to meet every contingency.

The reason that this question has never been definitely settled in a court of law is not far to seek. The consumer who has just sent in an application for a supply is naturally desirous to conciliate the company which is to furnish the current; and the certain knowledge that he will at some time get his deposit back allays the fears which he may entertain about demanding it. We have grave doubts, however, whether, if the question were tested in a suitable case, the company would come off victorious.

## THE NAVIGABLE WATERWAYS OF BELGIUM.

A FOREIGN OFFICE report by Mr. Consul-General Hertslet, has been issued upon the subject of the navigable waterways of Belgium, a subject that should appeal to traders in this country who suffer from the unfair and discriminating charges made by our English railways in favour of the foreigner. It would form a curious chapter in commercial history could the full tale be unfolded of how the canals of Great Britain have been allowed to fall into decay or into the hands of the railway companies, who have thereby been enabled to pour into their own coffers the savings that should have gone to the traders.

Some idea of the navigable waterways of Belgium may be gathered, when it is stated that each 8½ sq. miles of territory as an average goes to each mile of waterway, which is as though the country were divided up into rectangles 16 miles × 16 miles by means of canals on each four sides of the square, so that no point could be more than 8 miles from a canal. As in all countries, there is waste land in Belgium, so the parts which most need canals must indeed be very well served.

The Belgian canals are united to those of Holland, France, and Germany, in combination with such natural waterways as the Scheldt, the Lys, the Sambre, and the Meuse. With such a system carefully matured as it has been, the inland communications of the country are the means of diffusing life and activity from the lack of which so much of our own country suffers. The City of Antwerp, though well inland, is, nevertheless, on a fine estuarial river, and is one of the first ports of Europe. Though it is situated only a few miles within the Belgium border, it is the true centre of distribution, for as a port it is in touch with the British Isles and the Baltic, and it is the American port also. By inland waterways it is the point through which trade passes to Belgium and France in the South-West, and to Germany and the Low Country to the East and North. Thus Antwerp distributes raw material to the whole country, and collects the same in manufactured form.

Of the total of 1,360 miles of waterway, about 85 per cent. is under State control, and the State also holds shares in much of the remaining 15 per cent. Thus the State that controls so much of the railroads also is much in the same position as our English railways, were these more benevolently administered. The dues charged by the Belgian canals are very small, a barge of 100 tons being only charged 16s. for traversing 25 miles of canal, or less than 8d. per 100 ton-miles. During the past 25 years some £16,000,000 has been spent on the ports and canals alone.

In thinking of Belgian canals, we must disabuse our minds of the ideas which a mention of our English canals suggests. Good enough for canoeing on, and by no means everywhere unbeautiful, they are not deep, their banks are out of order and their tow-paths are thoroughly bad.

In the year 1902, 31,850 barges arrived in the port of Antwerp with a tonnage of 5,705,731, of which amount 3,710,813 tons were purely Belgian traffic. Clearing from Antwerp the barges were 33,250, measuring 5,939,674 tons. Since 1882 the number of barges has shown very little increase in or out, but the tonnage has nearly trebled. This simply shows the increase in the size of the barges. Those which are towed in and out of Antwerp in long lines have a tonnage of 1,500, and measure 250 ft. in length, 32 to 36 ft. beam, and draw 7 to 8 ft. loaded. They travel from 35 to 42 miles per day, and run through to Strasburg and Mannheim Rates for coal to Cologne are 2s. to 2s. 6d. per ton, as against 6s. 5d. by rail; 3s. to 6s. to Mannheim, as against 12s.; and 5s. to 7s. to Strasburg, as against 11s.

There are alternative routes, which are slower and more costly, but are much used when navigation by the Rhine is not convenient, and when produce, such as grain, bought cheap in Antwerp, is not required for some time, and it may pay to keep it a long time *en route* instead of warehousing it.

Our English barges of 20 to 50 tons are mere canoes in comparison with the Belgian barges, which are not over big at 350 tons, and are looked on as very small at 70 tons on the little Brussels—Charleroi canal. Some of the canals now only fit for 350 tons barges, are being enlarged for barges of 1,000 tons capacity. Others are being increased to take barges of 400 instead of 70 tons, and generally there is progress and development.

Some years ago a trial was made of overhead wires for electric haulage in the canal from Hol to Brussels, but the experiment was abandoned as unsuccessful after two years. We need not follow through the statistics as to coal, stone, slate and road metal, timber, flour, ores, chemicals, dyes, and metals which pass between different parts of Belgium and that country and France. They are well detailed in the report. Not alone in bargeways is progress made. From Gand to the sea the canal improvements are such, that when complete the surface width will be 212 ft., the depth 28½ ft., and the bottom width 78 ft. The new lock will be 650 ft. long. The dock area at Gand will be 212½ acres. Indeed, all through Belgium there is progress in canal work The various schemes in hand are sketched out, some of which consist of enlargements and other improvements, and others of new works such as junction canals to connect main systems across unserved areas. What is done is done on a system. There is homogeneity of treatment, and a broad view is taken of the whole country.

The existing canals of this country were, perhaps, good enough in their time; but when the trade of the country increased, and the railways came along, the latter at once became fashionable, and the canals were allowed to sink into unmerited oblivion. Everyone went mad over the railways, and allowed themselves to be led away into the belief that traffic by rail would be cheaper than by water. Then came an era of great brickness. Freight charges were, perhaps, not looked into too closely, for money was plentiful. The canals virtually disappeared, and now that competition is keen, and cheaper carriage is essential, the country must surely awake to the fact that it has lost a valuable asset. It is sincerely to be hoped that the efforts now being made to direct public attention to this important matter will be successful. We should advise everyone to procure Consul Herstlet's Report (Eyre & Spottiswoode, 11½d.). Its maps of the waterways and of the traffic volumes are instructive, the four main groups of produce—fuel, minerals, &c, wood, and agricultural and industrial products—being shown by coloured bands along the main route.

The disuse of canals in England must be responsible for many unworked quarries, and for the absence of many little industries which would aggregate large amounts.

The value of the imports carried by canal or river is nearly 20 per cent. of the whole imports of Belgium, while the exports amount to 24 per cent. of the whole. The values are 9·7 and 12·3 respectively, showing how very valuable is the cheap traffic for the cheaper classes of goods.

It is less in draught than in length and width that the Belgian barges are large, for the draught on various canals varies from 4 ft. 7 in., and even 4 ft. 3 in. to 5 ft. 10 in., 6 ft., 9 ft., and 11 ft. 3 in. On more important waterways the draught varies from 5 ft. 10 in. to 11 ft. 3 in. and 19 ft. 6 in. Obviously, the length of a barge is limited by the locks. Our English canals are very faulty in respect of locks, for these are very short as a rule. These short sections are very narrow, and there is a lack of system to emerge from which will, no doubt, require a hard struggle. Yet it is necessary that the struggle be made and the octopus grip of the railways loosened with benefit to everyone, perhaps even the shortsighted railways themselves.

In Great Britain there are two great examples of canal engineering. One is old and was carried out for military ends, namely, the Caledonian, and it is now of small size compared with the modern Manchester Ship Canal. That this cost so much more than it should have done, was, perhaps, not an example of good finance, and matters once buried are not altogether of the sort "men want dug up again," but it cannot be denied that the Manchester Canal has given a fillip to the trade and prosperity of South Lancashire, worth many times the cost of the canal. The Thames navigation is not what it should be, nor has the navigable Severn been kept up to date as regards its canalised portion which extends only to Stourport, and does not touch the further towns of Bewdley, Bridgeworth, nor the coalfield area of which Coalbrookdale is so well known a feature.

Canals ought to be so governed that they cannot fall under the blighting influence of other interests. An Inland Navigation Board of Conservancy might well be constituted. Capital is hardly likely to flow to canal-making if there remains the danger of the small investor being swamped.

The opposition of the railways to canals is very intense; it is also very inconsistent. The North-Western Railway, for example, opposed the Manchester Ship Canal on the grounds that it was not needed, could not be made, and, if made, would not be used. Only the legal mind could frame such reasons; for, if it could not be made, why did they waste money in opposing an impossibility, and if it would never be used, why did they at once take steps to use it by laying down branches to its banks?

Canals are wanted, but not for 20-ton boats dragged painfully by the superannuated cab-horse or docile mule. The canal is a means of transport by water, and this has long proved the cheapest sort of transport for slow and heavy traffic.

It is not generally known that a cylinder boiler of most approved make cannot be obtained as large as 9 ft. diameter from the North Country makers, because it cannot be brought by rail to London. Such a boiler would easily be brought by a canal of reasonable size. Indeed, it would float without a boat and come to no harm; but it could not pass all bits of the present canals, for some are so very narrow. This is but one instance where progress is checked for want of proper transport facilities. Our modern trade demands cheaper transport, and if this is not obtained, it cannot prosper as it should. Canal betterment ought to be the cry of every Chamber of Commerce.

## OVERHEAD TRAMWAY CONSTRUCTION.

By "LINEMAN."

In the following article it is proposed to deal with the whole question of the design, selection, arrangement, and erection of overhead line material, and, in doing so, it is not intended to propose anything new, but to discuss standard practices, and to point out the leading features of the best design.

Taking the material in the order in which it would be handled on a job, we first have to deal with the question of poles.

*Poles.*—Generally speaking, there are four types of steel poles in common use, the most popular being the three-section type; this, as its name implies, is constructed of three lengths of lap-welded pipe of different diameters, according to the ultimate strength of pole required. These sections are joined together by placing one inside the other for a distance of 18 in., and shrinking the outer on to the inner.

This type of pole gives every satisfaction, provided the joints are sound, but very careful inspection is necessary before they are passed. The fault is generally to be found at the weld of the outer pipe, which opens during the shrinking process, and is subsequently riveted up.

These poles were originally only obtainable in large quantities from America, but the material was poor, and the workmanship generally unsatisfactory, especially the jointing. This was probably responsible for that absurdly severe test which has survived to this day. I refer to the "drop test,"

which calls for the pole to be dropped three times butt first on to a block of iron from a height of 6 ft. This is an unnecessary test, as the lateral test proves the value of the joint under equivalent working conditions, and poles which fail the drop test are often quite satisfactory on the lateral test. This has led makers to use artificial means to meet the test. The Mannesmann Co. adopted the simple expedient of rolling an annular ring into the pole just below the 18 in. joint. This was quite effective for preventing the telescoping of the pole, but it was found that after the permanent load had been applied for some time, this depression straightened out on the tension side, and closed on the compression side, thus causing an ugly-looking kink to appear in the pole.

Returning to the question of tests, the most satisfactory calls for the pole to be supported in a horizontal position for a distance of 6 ft. from the butt end. On applying a certain load at a point 18 in. from the top, the temporary deflection must not exceed 6 in., and on increasing the load about 50 per cent., the permanent deflection must not exceed $\frac{1}{2}$ in.

This test proves the value of the joint better than any other, as, in the event of a fault, the whole of the bend would occur at that point instead of being taken up uniformly over the whole length. This even distribution of in a town, and nothing looks worse than to have to leave the pole without its base in order to gain the extra inch.

The thickness of metal is, of course, dependent on the strength required in the pole, but should certainly never be reduced below $\frac{1}{4}$ in. A reliable weld does not seem to be obtainable with a thinner metal, and the poles so easily deform in the handling, with a corresponding decrease in strength.

The material used should be a good quality Siemens-Martin mild steel, having a tensile strength of 26 to 30 tons per sq. in., with an elongation of at least 25 per cent. in 8 in.

The actual strength of pole required, depends on the class of construction and size of wire, and no exact rules can be given, as there are so many variable quantities. Side bracket construction can be erected with much lighter poles than for span work, but the 500-lb. poles occasionally used are undoubtedly too light.

Two or three sizes of pole are always sufficient, and as the result of experience on over 300 miles of tramway route, the following sizes may be of interest:—

| | |
|---|---|
| Span construction straight line work ... ... | 750 lbs. |
| Curve span construction ... ... ... ... | 1,000 „ |
| Pull-off poles ... ... ... ... ... | 1,200 „ |
| Anchor poles ... ... ... ... ... | 2,000 „ |

POLES SPECIFIED OR USED ON VARIOUS TRAMWAYS DURING THE LAST FEW YEARS.

| Town. | Total length. | No. 1 Pole. | | | | | | | | | No. 2 Pole. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Top section. | | | Middle section. | | | Bottom section. | | | Top section. | | | Middle section. | | | Bottom section. | | |
| | | Diameter. | Thickness. | Length. | Diameter. | Thickness. | Length. | Diameter. | Thickness. | Length. | Diameter. | Thickness. | Length. | Diameter. | Thickness. | Length. | Diameter. | Thickness. | Length. |
| | ft. in. | in. | in. | ft. in. | in. | in. | ft. in. | in. | in. | ft. in. | in. | in. | ft. in. | in. | in. | ft. in. | in. | in. | ft. in. |
| Aberdeen ... ... | 31 0 | 5 | ·26 | 7 6 | 6 | ·31 | 9 6 | 7 | ·40 | 17 6 | | | | | | | | | |
| Batley ... ... ... | 31 0 | 5 9/16 | ·3 | 7 6 | 6 5/8 | ·38 | 9 6 | 7 5/8 | ·47 | 17 6 | 6 5/8 | ·3 | 7 6 | 7 5/8 | ·4 | 9 6 | 8 5/8 | ·5 | 17 6 |
| Colchester ... ... | 31 0 | 5 1/2 | ·25 | 7 6 | 6 1/2 | ·25 | 9 6 | 7 3/8 | ·37 | 17 6 | 5 1/2 | ·25 | 7 6 | 7 1/2 | ·25 | 9 6 | 8 3/8 | ·37 | 17 6 |
| Derby ... ... ... | 31 0 | 5 1/2 | ·25 | 7 6 | 6 1/2 | ·25 | 9 6 | 7 3/8 | ·37 | 17 6 | 5 1/2 | ·25 | 7 6 | 7 1/2 | ·25 | 9 6 | 8 3/8 | ·37 | 17 6 |
| Glasgow ... ... | 30 0 | 5·8 | ·4 | 8 0 | 6·9 | ·45 | 9 0 | 8 | ·5 | 16 0 | 6·9 | ·45 | 8 0 | 8 | ·5 | 9 0 | 9 | ·5 | 17 0 |
| Newport ... ... | 31 0 | 5·6 | 3 | 7 6 | 6·16 | ·38 | 9 6 | 7·94 | ·47 | 17 0 | 6·6 | ·2 | 7 6 | 7·8 | ·4 | 9 6 | 9·2 | ·6 | 17 0 |
| Southend ... ... | 31 0 | 5 9/16 | ·3 | 7 6 | 6 5/8 | ·38 | 9 6 | 7 5/8 | ·47 | 17 0 | 6 5/8 | ·3 | 7 6 | 7 5/8 | ·6 | 9 6 | 8 5/8 | ·6 | 17 0 |
| South Lancashire ... | 31 0 | 5 1/2 | ·259 | 9 0 | 6 5/8 | 3 | 8 0 | 7 3/4 | ·4 | 17 0 | 6 5/8 | ·3 | 9 0 | 7 3/4 | ·4 | 8 0 | 9 | ·5 | 17 0 |
| Nottingham ... ... | 31 0 | 5 9/16 | ·284 | 7 6 | 6 5/8 | ·3 | 9 6 | 7 5/8 | 1/2 | 17 0 | 6 5/8 | 3/8 | 7 6 | 7 5/8 | 1/2 | 9 6 | 8 5/8 | 3/8 | 17 0 |
| Devonport ... ... | 30 0 | 4 1/2 | 1/4 | 7 6 | 5 5/8 | 9/32 | 9 6 | 6 5/8 | 1/16 | 16 0 | 5 1/8 | 1/4 | 7 6 | 6 5/8 | 5/16 | 9 6 | 7 5/8 | 3/8 | 16 0 |
| Warrington ... ... | 31 0 | 5 | 1/4 | 7 6 | 6 1/2 | 5/16 | 9 6 | 7 1/2 | 3/8 | 17 0 | 6 | 5/16 | 7 6 | 7 1/2 | 5/16 | 9 6 | 8 1/2 | 3/8 | 17 0 |
| Burton ... ... ... | 31 0 | 5 1/2 | ·259 | 9 0 | 6 5/8 | 3 | 8 0 | 7 3/4 | 4 | 17 0 | 6 3/8 | ·3 | 9 0 | 7 3/4 | ·4 | 8 0 | 9 | ·5 | 17 0 |
| Lowestoft ... ... | 31 0 | 5 | 3/16 | 7 6 | 6 | 1/4 | 9 6 | 7 | 3/8 | 17 0 | 6 | 3/16 | 7 6 | 7 | 5/16 | 9 6 | 8 | 3/8 | 17 0 |
| Reading ... ... | 31 0 | 5 1/2 | 259 | 7 6 | 6 5/8 | ·3 | 9 6 | 7 3/4 | ·4 | 17 0 | 6 5/8 | ·3 | 7 6 | 7 3/4 | ·4 | 9 6 | 9 | 5 | 17 0 |
| Swindon ... ... | 31 0 | 5 9/16 | ·3 | 7 6 | 6 5/8 | ·38 | 9 6 | 7 5/8 | ·47 | 17 0 | 6 5/8 | ·3 | 7 6 | 7 5/8 | ·4 | 9 6 | 8 5/8 | ·5 | 17 0 |
| King's Norton ... | 31 6 | 4 1/2 | ·187 | 9 6 | 5 9/16 | ·25 | 9 6 | 6 5/8 | ·34 | 16 0 | 5 9/16 | ·25 | 9 6 | 6 5/8 | ·32 | 9 6 | 7 5/8 | ·4 | 16 0 |
| Rochdale ... ... | 31 0 | 5 9/16 | ·3 | 7 6 | 6 5/8 | ·38 | 9 6 | 7 5/8 | ·47 | 17 0 | 6 5/8 | ·3 | 7 6 | 7 5/8 | ·4 | 9 6 | 8 5/8 | ·5 | 17 0 |
| Leicester ... ... | 31 0 | 5 5/8 | 1/4 | 7 6 | 6 5/8 | 5/16 | 9 6 | 7 5/8 | 13/32 | 17 0 | 6 5/8 | 1/4 | 7 6 | 7 3/4 | 3/8 | 9 6 | 9 | 1/2 | 17 0 |

the bend should always be specified, yet no mention is ever made of it.

The two test loads referred to above, are those always used to describe the pole. This is an exceedingly useful method, as it gives the strain the pole will stand under working conditions, and therefore it will be understood that a 700—1,200-lbs. pole refers to the strength, and not the weight.

After the "three-section" pole, the most common is the "taper pole," rolled from one plate of steel, with a lap-welded joint running the whole length. This pole is really parallel for a distance of about 17 ft. from the butt, and then tapers to the top. The result is an exceedingly graceful looking pole. It is made in an excellent quality of steel, and is extremely reliable.

A study of tramway specifications issued during the last five years shows that the most common pole is the three-section pole, having its outside diameters 5⅝ in., 6⅝ in., 7¾ in. respectively—quite 50 per cent. of the tramways use this pole. Recent specifications, however, show a tendency to revert to even outside dimensions, and considering that all the fittings on tramway poles are dependent on the outside diameters, the practice seems a wise one. A small diameter pole gives an appearance of weakness which is not desirable, and the reverse is, of course, an obstruction, which must be guarded against. There are always some narrow pavements

The anchor pole can generally be more conveniently replaced with two pull-off poles, and whether a 750 lbs. or 1,000 lbs. pole is used for the main work, depends upon the amount of curve work on the job.

Great care should be used in the placing of the poles, in order to get the minimum strain on them, and for this it is well to remember that the lightest pull is always at right angles to the wire, and the straighter a bridle wire the greater the strain on the poles. It is difficult to make linesmen understand this, and therefore they require careful watching.

Sufficient care has not been taken to protect the inside of poles from rust. Poles in certain parts of the country are undoubtedly rusting away on the inside, and this could have been easily and cheaply prevented by a good coat of tar on the inside, immediately after manufacture.

To improve the appearance of the pole, cast-iron ornamental bases, joint rings and finials are employed. These are of endless designs, and generally the work of the local art school. This is unfortunate, as they generally produce a beautiful picture with a mass of delicate flowery ornamentation, all of which is quite lost in the casting, or is quite invisible a few yards away, a decided outline with some plain, bold relief work being all that is necessary, and equally, if not more, effective.

Care should be taken to provide ample clearance on the inside of these castings, otherwise the unavoidable roughness

will render them difficult to place in position ; $\frac{3}{8}$ in. clearance all round is the minimum that should be allowed, except at the top, where $\frac{3}{16}$ in. is sufficient ; this space should be filled with a lead caulk. Cement has frequently been tried, but the change of temperature causes it to crack and eventually break away. It is not necessary to caulk the joint collars, but they should certainly be carefully painted on the inside, and also lifted up to allow the pole to be painted underneath. If this is not done, the rust caused by rain-water runs down the side of the pole, and totally spoils the paint. The thickness of metal in bases need not exceed $\frac{3}{8}$ in., and rings and finials $\frac{1}{4}$ in. This gives sufficient strength without waste of metal.

Bracket arms have become standard so far as the arms and stay rods are concerned—being composed of $2\frac{3}{8}$ O.D. lap-welded steam pipe, with $\frac{3}{4}$ in. stay rods. The attachment of the pipe to the pole, is obtained by a split malleable iron casting with the pipe expanded into one-half and pinned right through—two, and occasionally four bolts being used to bolt the whole to the pole.

It is not advisable to clamp the pole too tightly, as in the event of a wire breaking, it is better for the bracket-arm to give slightly by turning on the pole and so slackening the wire, than to attempt to hold the line by putting a heavy strain on the clamping casting, which would probably break. For the same reason it is not advisable to screw the pipe into the cross casting, owing to the weakening at the thread. Screwing the pipe is only done where the strain is a direct pull, as in the case of span brackets.

It is better to take the stay rods from wrought-iron pole straps at the top of the pole, which straps should be quite independent of the ornamental scroll work.

The adjustment of the rod is usually provided at the point of attachment to the arm, the bracket casting being slotted to clear the screwed end of the rod, which is provided with a nut and a spherical washer, the advantage of the slot and spherical washer being that the bracket casting is standard for all lengths of arm.

For span brackets, a slightly lighter pipe is sufficient, the usual size being $1\frac{1}{2}$-in. instead of 2-in. pipe.

The ornamental scrollwork for brackets is attached to the arm and pole by separate malleable or wrought-iron clamps, the section of iron usually employed being $1\frac{1}{2} \times \frac{5}{16}$, but this, of course, depends on the effect desired. A heavy-looking scroll can be cheaply produced without increase in weight, by using round instead of flat section iron.

Wires used for spans and guard wires are, almost without exception, composed of seven strands of No. 12 and 16 galvanised steel, double wires being used where extra heavy strains are to be taken.

Ordinary commercial wire is now so excellent, both in material and galvanising, that special precautions are unnecessary ; if required, a wire can be made to stand any reasonable tensile strain, but this is done at the expense of its ductility, and to meet the heavy tests called for by some engineers, the wires have to be made so brittle and springy that it is almost impossible to nozzle a tight reliable joint. It is also important for a tight joint that the lay of the strands should be right-handed.

For use in towns subject to corrosive fumes, phosphor bronze should be used, or the wire regularly coated with vaseline. Both, however, add considerably to the cost, and to overcome this a steel wire with a thin copper case has been introduced, but has not, so far as the writer is aware, been used in any town.

*Line Insulators.*—These are a most important part of a line, and too much care cannot be used in their selection, as the failure of any one invariably causes a delay in the traffic and may result in serious accident. All insulators and their supporting castings should be designed for a maximum strength with a minimum amount of metal. The reduction of weight on large junctions is of great importance, and in setting out a line care should be taken to place the supporting spans to the greatest advantage.

With regard to strength, two types of fittings can be employed. Those used for supporting the line on straight routes should have a breaking strain of at least $2\frac{1}{2}$ tons, and material used for pull-offs and anchors, should test over $3\frac{1}{2}$ tons. Whilst insisting on these tests, care should be taken that the metal is not too brittle ; a deformed casting will be noticed by the inspecting gangs, and removed, whilst a brittle casting gives no warning.

First-class Admiralty mixture is, undoubtedly, the best to use, though good malleable iron is a reliable substitute, for cheap construction, but in buying fittings it is well to remember that they take more than a day to make—points frequently overlooked by tramway companies in a hurry.

Line fittings which embody insulating material should be designed so that the insulated portions will mechanically lock when the insulating material breaks down. The insulating material should be in compression excepting where used to give extra surface, as in the case of globe strains, &c.

The insulating materials in common use are all very much the same, the best known being the Aetna and Hecla varieties. Generally speaking, the material employed should be of a hard nature, yet not brittle or scaly, and should have a smooth glossy surface in the finished article. It should be capable of sustaining heavy pressures without change of shape, be impervious to rain water, free from any weathering effect, and remain hard at temperatures up to 250° C. This last is most important, as a large number of insulators have undoubtedly broken down owing to the heat generated by surface-leakage currents softening them. This is especially the case where the second insulators have broken down or, being faulty, the line is dependent on the insulating bolt at the ear—a poor one at the best of times, and on old lines frequently useless.

The short surface of the insulator bolt with iron and brass at each end seems, when damp, to allow of some local action which causes a conducting film to form on the insulators, and which, unless frequently wiped off, renders the bolt useless.

The practice of providing straight line hangers, &c., with petticoats to keep off the rain, seems to be quite a mistake, as it prevents the very necessary washing which a good rain storm provides, and does not keep the insulator dry, every passing trolley wheel throwing up sufficient water to make the whole thing wet. The type of complete insulator known as the cap and cone is very much better for this reason than the West End or Boston types. Its great fault, however, is that the cap is liable to unscrew, and so release the line. This could be easily overcome by encasing the cap in metal and locking it in position with a projecting lug similar to the cap of a West End hanger.

The West End type, though most frequently used, is by no means so good as the Boston, owing to the metal having to be cast rather thin in order to keep the weight within bounds, producing a liability to tear immediately it starts to deform under a heavy load.

The greatest possible care should be used in testing the metal and selecting the final castings for double pull-offs. These, of necessity, have a weak section, and any castings having the slightest sign of a flaw should be at once rejected —and every casting should be inspected and a percentage of every cast tested.

The ears for attaching the trolley wires to the supports are of a familiar design, and not open to much variation. Their height should be as short as possible, in order to reduce the leverage on curves, and the boss in the centre of such a shape that it does not foul the trolley head, due allowance being made for the wear of the wheel. The groove for the wire should be sufficiently deep to allow the lips to lap about three-quarters of the circumference of the wire, the ends being tapered off for about 2 in. to allow an easy run on or off.

Before erection, a close inspection of ears should be made for flaws in the casting ; these usually occur round the boss. A percentage of ears in each cast should also be bent at right angles to test the brittleness of the metal, and to develop any hot cracks.

The best of ears are liable to these cracks, which are due to the practice of striking the hot ear a sharp blow to remove any excess of solder after tinning—an operation which should, of course, be done by wiping.

It is occasionally specified that the grooves shall be milled. This is an unnecessary expense, as an emery wheel will remove any roughness much more cheaply and quite as efficiently.

The length of the ear, of course, depends on its situation. For straight-line work, 15 in. is sufficient, but for curves 18 in. or 24 in. are necessary, and these should be strengthened with side ribs, in order that the bend may be distributed evenly over the whole length. Over 24 in.

the extra metal necessary to do this renders the ear too heavy, and the 36-in. ears occasionally used are pure waste of money, as 6 or 8 in. at each end are always straight.

In designing splicing ears and section insulator ends, it is well to remember that these have to stand the full working strain of the trolley wire, and must, therefore, have the same breaking test; the working load of copper is quite three times as high as that of gun-metal, when the latter is used for small sections.

The street controlling switchgear does not vary very much on any system.

An overhead line is divided into ½-mile sections by means of section insulators, and current is supplied at the centre of each section, or at the section insulators. The only advantage of feeding at the centre being the rapidity with which the sections can be isolated in the event of a breakdown.

In early tramway work it was the custom to insulate the up from the down trolley wire, and the switchgear then required at the section points, was four 100-ampere line switches, feeding on a common bus-bar; but now the two lines are always in parallel, and it is only necessary to have two switches for bridging the section insulators. In order, however, to have a panel uniform, except for the absence of the feeder switches, with the feeder panels, they are always provided with four line switches, and are then easily converted if necessary.

Until recently the switches were always mounted on enamelled slate or polished marble, but there is now a demand for what might be called a skeleton panel, that is to say, the switches are mounted on iron or ebonite cross-bars, and insulated from them by some suitable tramway insulating material, the cross bars being again insulated from the containing box.

In order to reduce the overall dimensions of the box, the switches have been so crowded together that the panel is weakened, and the surface distance to earth reduced to a minimum. The result has been a failure of insulators, and to improve this the switches were separately insulated from the marble and the marble from the box; having arrived at this stage, the obvious thing to do was to substitute iron cross bars for the marble.

The design of switches need not be discussed here, as standard switchboard practice will apply. It is merely necessary to mention that only the double break type should be used, the reason being that both sides of the switch are frequently alive, and with an open switch a live blade would be extremely dangerous.

Fuses and circuit-breakers in boxes are most unsatisfactory, as in the event of their acting, the delay to traffic is enormous, and the arcs they are liable to form in such a confined space are most objectionable—frequently destroying the whole gear.

In conclusion, I would urge upon all engineers to thoroughly inspect their material, and to remember that there is a minimum price at which good material can be supplied and erected; below that price means inferior work or low grade metal, and the blind acceptance of the lowest tender is simply courting disaster.

## ROYAL SOCIETY CONVERSAZIONE.

THE first annual conversazione of the Royal Society took place at Burlington House on the 13th inst. A large number of interesting scientific exhibits were on view, but only a small proportion of these were of special interest to electricians.

Prof. Fleming exhibited an elaborate apparatus for the metrical study of stationary electric waves on spiral wires. The apparatus consisted of a long solenoid of silk-covered wire having 5,000 turns and a total length of 643 metres. This solenoid has parallel to it an adjustable earth wire and a divided scale. The solenoid is connected to one point on an oscillatory electric circuit, consisting of a couple of Leydens, having a capacity of 0·00068 mfd., an adjustable inductance of 0 to 230 microhenrys and a silent discharger. When oscillations are set up in this circuit by induction coil discharges and the frequency adjusted, stationary electric waves are started in the solenoid. The position of the loops and nodes is ascertained by the use of a series of carbon dioxide vacuum tubes. The position of the first node is always well defined. Theory indicates that the distance from the end of the solenoid to the first node should be to the distance between the first and second nodes in the ratio of 1 : 2·5, and that the distance between the first and second nodes should be half a wave length. Experiments with the apparatus give a mean value of 1 : 2·4 for the above ratio for the first five odd harmonics. The inductance of the long spiral is 100 microhenrys per centimetre of length and its capacity is $26 \times 10^{-8}$ of a microfarad per centimetre of length. From these data it was found that the velocity of the wave along the spiral was about 196 centimetres per second. From the wave lengths experimentally determined, the corresponding frequencies were then found, and these agreed substantially with the frequencies as calculated. Thus, corresponding to the first odd harmonic, the node is 64 centimetres from the end. The inductance in jar circuit is then 79 microhenrys, and the frequency as determined from the node position and wave velocity is 720,000 complete oscillations per second; while from the jar circuit inductance and capacity it is 690,000, showing a fair agreement.

Mr. W. Hibbert and Mr. H. E. Dick exhibited the Edison secondary battery as adapted for use on automobiles. The positive plate has finely divided iron as the active material; the negative plate has nickel peroxide. The containing grids are shallow pockets made of thin perforated steel carried in a thin steel frame. Both pockets and frame are nickel plated. The liquid is 20 per cent. potash. The plates and liquid are in a nickel plated steel box sealed at the top except for a gravity valve, by which gases can escape during charging. There is also a spring valve through which distilled water can be put in from time to time. This is the only thing required beyond the electrical charging. The output is about 13 to 14 watt-hours per pound of cell. There is no corrosion of the plates. A complete cell, several parts, sections and active materials were shown.

Colonel Crompton exhibited a number of electrical instruments of precision. An electrical micrometer for measurements of screws or other small mechanical parts was arranged so that contact of the part with the micrometer screw was detected by the click of a telephone in circuit with the parts. This method is extremely delicate and very easily manipulated. Other instruments exhibited were: a spherical electrostatic voltmeter, designed by Mr. W. A. Price; a set of standard resistances; a standard resistance for potentiometer measurements of currents, to take 1,000 amperes; a Wheatstone bridge (new form); a combined voltmeter and ampremeter.

The National Physical Laboratory exhibited a microphone-buzzer (with partially-tuned telephone) capable of giving a pure note of 2,000 per second; an apparatus used to investigate the distribution of temperature in the field coils of electrical machinery; and an apparatus for rapid electric thermometry. The buzzer is for the purpose of giving alternating currents for use in measuring inductances and capacities. It consists of a thick steel rod supported at nodal points, and carrying a light microphone. The microphone is in circuit with the battery and the primary coil of a small transformer. The secondary circuit of the transformer is connected to a polarised electro-magnet placed close to the steel rod. Vibrations started in the rod, cause ripples in the microphone current, and these in turn give an alternating current in the electro-magnet which by attracting the rod maintain it in steady vibration. For inductance measurements the indicating instrument is a telephone. For high frequencies the telephone is tuned to the proper pitch by a screw pressing against the diaphragm.

Mr. Bertram Blount exhibited electric resistance furnaces for laboratory use. These furnaces are designed for such analytic operations as the determination of oxygen in copper and carbon in steel, replacing the gas furnaces usually employed for these purposes. In one furnace the resistance material was a mixture of graphite and siloxicon packed in the annular space between the porcelain tubes, and held between end clamps of metal. In another furnace designed by Heraeus, the resistance was a very thin strip of platinum foil closely applied to the tube to be heated. Temperatures

up to about 1,500° C. can be easily obtained in a short time.

The immense advantages to be gained from good heat insulation in furnaces were shown in a striking manner in some muffle and melting furnaces for use in laboratories and art studios, exhibited by Mr. H. H. Cunynghame, C.B. The plan on which these furnaces are constructed is to jacket them thickly with non-conducting material in such a way that heat cannot escape as fast as it is developed. By this plan muffle furnaces can be heated with one-fourth to one-sixth the amount of gas or petroleum required in non-jacketed furnaces. A single Bunsen burner may be used for muffles up to 7 in. in width, and no flues are required to carry off the fumes.

Mr. Sherard Cowper-Coles exhibited experiments to show the action that occurs between metals at a temperature many hundreds of degrees below their melting point. Iron, copper and its alloys, aluminium, nickel, cobalt and the rarer metals can be coated with zinc by placing them in zinc dust and heating them to a temperature some 200° below the melting point of zinc. The process is being successfully applied to coating iron with metallic zinc, a process to which the name of Sherardising has been given.

The most sensational event of the evening was the demonstration of the loud speaking phonograph or auxetophone invented by the Hon. C. A. Parsons. The auxetophone is an air-operated valve which is used for a reproducer in gramophones and phonographs, and replaces the usual reproducing diaphragm in such machines. Speech was given out with a loudness far exceeding that of the human voice, and music, vocal and instrumental, was especially well rendered.

## NEW PATENTS APPLIED FOR, 1904.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

10,598. "Improvements relating to the conductors and rails of electric and the like railways." E. E. Kelsey. May 9th.

10,646. "Improvements in or relating to controlling or regulating means for electrical apparatus." A. J. Boult (J. B. Entz, United States.) May 9th. Complete.)

10,647. "Improvements in bearings for the motors of electrically propelled vehicles." C. de Kando. May 9th. (Complete.)

10,648. "Improvements in or relating to electric motor systems." C. de Kando. May 9th. (Complete.)

10,656. "Improvements in and relating to enclosed fuses for electrical installations." W. Fellenberg. May 9th.

10,662. "Improvements in or relating to the supply of current to electrically propelled vehicles on railways." C. H. Merz and A. H. Marshall. May 9th.

10,667. "Improvements in actuating mechanism for secondary electric clocks and other intermittently electrically impelled apparatus." P. M. Justice. (J. S. Moise, United States.) May 9th.

10,672. "Improvements in gas or vapour electric apparatus." F. W. Le Tall. (The Cooper Hewitt Electric Co., United States.) May 9th.

10,691. "Electrically-operated typewriters." W. J. Roussel and A. King. May 9th. (Complete.)

10,722. "Improvements in and relating to reverse current electric circuit breakers." L. Andrews. May 10th.

10,723. "Improvements in and relating to reverse current relays for electric circuit breakers." L. Andrews. May 10th.

10,727. "An improved electrically-operated travelling perforating machine." G. Kirk. May 10th.

10,755. "Self-regulating (electrical) bactericlogical incubator." A. R. Bankart. May 10th.

10,794. "Improvements in and relating to electrolyte apparatus." H. S. Blackmore and E. A. Byrnes. May 10th. (Complete.)

10,812. "Improvements in overhead trolleys or conductors for electric tramway and railway vehicles." T. Blaney. May 10th.

10,818. "A device for winding up clocks automatically by means of an electric motor." G. D. Barile. May 10th. (Complete.)

10,836. "Improvements in registering apparatus for meters for gas, electricity, water or other fluids." J. H. Henderson and C. Napier-Higgin. May 11th.

10,887. "Improvements in fuse leads for electric blasting." F. Render. May 11th.

10,889. "New or improved device for protecting electric circuits and apparatus." S. E. Fedden and W. J. Howard. May 11th.

10,840. "An improved life-guard for electric tramway cars and similar vehicles." F. Wagstaff and S. R. Cameron. May 11th.

10,858. "Improvements in receiving apparatus for wireless telegraphy." L. Cerebotani and A. Silbermann. May 11th. (Complete.)

10,873. "Improvements in the manufacture of electric incandescent bodies." A. Voelker. May 11th.

10,878. "Improvements in device for protecting alternating-current apparatus." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) May 11th.

10,882. "Improvements in electric meters." The British Thomson-Houston Co., Ltd., and F. Holden. May 11th.

10,896. "Improvements in electric installations." J. Y. Johnson. (The Elektrizitats-Aktien-Gesellschaft vormals W. Lahmeyer & Co., Germany.) May 11th. (Complete.)

10,906. "Improvements in apparatus for electrically stopping railway trains." B. Lichtenfels. May 11th. (Complete.)

10,939. "Electric tramways point and frog mover." R. Peck. May 12th.

10,957. "Means to facilitate placing the poles or arms of electric cars in contact with the overhead wire." A. Pringle. May 12th.

10,986. "Improvements in printing telegraphs." R. J. Sherry. May 12th. (Complete.)

11,040. "Improvements in electric fire alarms." J. F. A. Lueckert. May 13th.

11,041. "Improvements in automatic electric circuit-breakers." A. Eckstein and D. B. Mellis. May 13th.

11,056. "Improvements in ceiling or wall rosettes for electric lighting and heating." A. P. Lundberg and G. C. Lundberg. May 13th.

11,072. "Improvements in electric resistances." The British Thomson-Houston Co, Ltd. (Allgemeine Elektricitäts-Gesellschaft, Germany.) May 13th.

11,073. "Improvements in and relating to electric switches." The British Thomson-Houston Co., Ltd. (Allgemeine Elektricitäts-Gesellschaft, Germany.) May 13th.

11,074. "Improvements in and relating to signalling systems." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) May 13th.

11,075. "Improvements in and relating to block signalling systems." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) May 13th.

11,076. "Improvements in and relating to signalling systems." The British Thomson-Houston Co., Ltd. (General Electric Co, United States.) May 13th.

11,077. "Improvements in and relating to signalling systems." The British Thomson-Houston Co, Ltd. (General Electric Co., United States.) May 13th.

11,078. "Improvements in and relating to signalling systems." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) May 13th.

11,079. "Improvements in and relating to signalling systems." The British Thomson-Houston Co, Ltd. (General Electric Co., United States.) May 13th.

11,080. "Improvements in and relating to signalling systems." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) May 13th.

11,081. "Improvements in and relating to safety devices for signalling systems." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) May 13 h.

11,089. "Improvements in electrostatic instruments." The British Thomson-Houston Co., Ltd. (General Electric Co, United States.) May 13th.

11,090. "Improvements in and relating to electric switches." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) May 13th.

11,093. "Improvements in and relating to electric meters." C. W. Atkinson. May 13th.

11,107. "Improvements in and relating to electric lighting and heating apparatus." C. H. van Aspern, C. B. Robinson, and H. W. van Raden. May 13th.

11,111. "A new or improved electrically-operated hoisting winch." A. J. Gustin. May 13th.

11,116. "Electrical signalling." L. A. Hards. May 13th.

11,141. "Improved method of winding armatures of dynamo-electric machines." W. A. Ker and Paterson, Cooper & Co., Ltd. May 14th.

11,168. "Improvements in safety devices for protecting dynamo-electric machinery and the like against the excessive voltage occuring when they are switched in or out." The Elektricitats-Actien-Gesellschaft Vormals W. Lahmeyer & Co. (Date applied for under Patents Act, 1901, June 23rd, 1903, being date of application in Germany.) May 14th. (Complete.)

11,177. "An improvement in electricity meters." I. Revilliod. May 14th.

## PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

### 1903.

Electric Cut-outs. G. S. Sluce and F. Chase. 3,866. February 18th.

Fixture-Studs for Electrical Conduits. A. G. Brookes. (H. D. Beets and R. M. Thomas, U.S.) 3,939. February 19th.

Construction of Armatures for Alternating Current Electric Motors. H. A. Mavor, W. F. Grafton, and Mavor & Coulson, Ltd. 4,077. February 20th.

Electric Regulating Switches. H. W. Dix. 4,275. February 24th.

Electrical Resistances. R. W. Paul. 4,388. February 25th.

A Chain and Pulley Combination Appliance Utilised for Raising and Lowering Weights at the Extremity or other Part of a Curve and Protecting Electrical Conductors or other Material from the Moving Rope. J. Stevenson, Jr. 4,390. February 25th.

Rail Bonds for Electric Railways. C. Bauer. (The Helios Electricitäts Aktiengesellschaft, Germany.) 4,442. February 25th.

Regulating the Voltage of Alternating and Continuous Current Generators by means of Alterate Current Excitations. Crompton and Co., Ltd., and R. Goldschmidt. 4,533. February 26th.

Telephone Receivers. W. G. Heys. (The Hutchison Acoustic Co, U.S.) 4,504. February 28th.

Bobbins or Formers, Brush Holders and the like, used for Electrical Purposes. W. Appleyard. 4,781. March 2nd.

Electric Switch for Motor Cycles and Vehicles. C. T. Mason. 5,011. March 4th.

Electric Arc Lamps. C. Oliver. 5,046. March 4th.

Contact Breakers for Induction or Sparking Coils and the like. R. W. Sanders. 5,150. March 5th.

Electric Motor Control Systems. E. A. Carolan. (The General Electric Co., United States.) 5,170. March 5th.

Brakes, Particularly Applicable to Brakes for Electric Tramcars. T. Vickers and E. Andrews. 5,204. March 5th.

Rotary Fans. E. A. Carolan. (The General Electric Co., United States.) 5,289. March 6th.

Electric Train Control Systems. E. A. Carolan. (The General Electric Co., United States.) 5,292. March 6th.

Apparatus for Measuring Electric Resistances. S. Evershed and Evershed & Vignoles, Ltd. 5,492. March 9th.

Electric Motors and Regulating Devices for Railway Trains or Vehicles Actuated by Electrical Energy. J. S. Raworth. 5,494. March 9th.

Dynamo-Electric Machines. F. Porsche. 5,661. March 10th.

Clutches, Brakes, Dynamometers and the Like. H. S. Hele-Shaw. 5,730. March 12th.

Electrical Measuring Instruments. W. C. Fisher. 5,741. March 12th.

Electro-Magnetic Stopping Device for Shuttles Embroidery and similar Machines. H. Beyrich. 5,795.